COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

VISION AND MISSION OF THE INSTITUTE

VISION

The Institute strives to inculcate a sound knowledge in Engineering along with realized social responsibilities to enable its students to combat the current and impending challenges faced by our country and to extend their expertise to the global arena.

MISSION

The Mission of Coimbatore Institute of Technology (CIT) is to impart high quality education and training to its students to make them World-Class Engineers with a foresight to the changes and problems, and pioneers to offer innovative solutions to benefit the nation and the world at large.

COIMBATORE INSTITUTE OF TECHNOLOGY
(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

DEPARTMENT OF COMPUTING-ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

VISION AND MISSION OF THE DEPARTMENT

VISION

Department of Computing-Artificial Intelligence and Machine Learning endeavours to make the students, world class software engineers, cutting edge researchers in Artificial Intelligence (AI) and Machine Learning (ML) and data engineers with prudence of pioneering solutions to challengers of the nation and the world.

MISSION

M1: To impart strong conceptual knowledge along with intensive practical training and real time industry/research project exposure to the students.

M2: To provide a learning ambience to enhance innovations, problem solving skills, leadership qualities, team spirit and ethical responsibilities.

M3: To establish Industry Institute Interaction program to provide exposure to a) latest AI, ML tools and technologies used in the IT organizations and enhance the entrepreneurship skills b) domain specific problems that will benefit from AI, ML solutions.

COIMBATORE INSTITUTE OF TECHNOLOGY
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DEPARTMENT OF COMPUTING-ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

MSc. Artificial Intelligence and Machine Learning

(Five-Year Integrated Programme)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Our Graduates will:

PEO 1: Develop software solutions demonstrating intelligent behaviour, handling uncertainty, constantly learning, and effectively using domain knowledge

PEO 2: Promote research in intelligent technology and concepts

PEO 3: Participate in life-long learning for effective professional growth and demonstrate leadership qualities to co-ordinate cooperative team in contributing for the betterment of the society.

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DEPARTMENT OF COMPUTING-ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

MSc. Artificial Intelligence and Machine Learning

(Five-Year Integrated Programme)

PROGRAMME OUTCOMES (POs)

Graduates of the programme will be able to:

PO1: Apply skills and concepts of computer science to abstract, design and code computing models and software solutions, from requirements of a problem.

PO2: Analyze real world problems, customer requirements from the perspective of developing software of good quality.

PO3: Analyse, design, develop and implement software solutions that meet requirements and can evolve to meet changes in the requirements.

PO4: Apply mathematical and statistical models to explore and analyze the massive amount of data in various domains.

PO5: Use techniques, skills and tools of both hardware and software including (but not limited to) programming languages, operations research, data storage, decision theory, knowledge representation, visualization, privacy, security to develop scalable techniques for software programming, data analysis, and design.

PO6: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

PO7: Recognize the need for, and have the ability to engage in independent and life-long learning.

PO8: Design and develop Artificial Intelligence and Machine Learning systems for analysing the varied, voluminous data in fields of medicine, business, geosciences, legal, scientific research and other domains.

PO9: Recognize the importance of innovation and develop a critical and research thinking approach to develop leading innovative intelligent software products.

PO10: Recognize social, professional, cultural, humane and ethical values and issues involved in the use of software technology and consider these adequately in developing and deploying systems.

PO11: Communicate effectively, domain and technical information with decision makers and team members, to derive software systems of high quality.

PO12: Enhance self-learning as well as capability to adapt to emerging technologies and create innovative solutions for challenging issues of society, engineering and education as part of an organization or as an entrepreneur.

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DEPARTMENT OF COMPUTING-ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

MSc. Artificial Intelligence and Machine Learning

(Five-Year Integrated Programme)

Curriculum from the Academic Year 2019 - 2020 onwards

Semester I

Course Code	Course Name	L	T	P	C	CAT
19MAM11	Technical English	2	0	0	2	HS
19MAM12	Applied Algebra	3	0	0	3	BS
19MAM13	Fundamental Statistical Methods	3	0	0	3	BS
19MAM14	Data Structures	3	0	0	3	PC
19MAM15	Theory of Programming Languages	3	0	0	3	PC
	PRACTICALS					
19MAM16	Algebra and Statistics Lab	0	0	4	2	PC
19MAM17	Data Structures Lab	0	0	4	2	PC
19MAM18	Python Programming Lab	1	0	4	3	PC
19FYEL11	Employability Skills	0	0	2	1	EEC
	Total Credits				**22**	

Semester II

Course Code	Course Name	L	T	P	C	CAT
19MAMLE01	Professional English	2	0	0	2	HS
19MAM21	Applied Calculus	3	0	0	3	BS
19MAM22	Probability Distributions and Applications	3	0	0	3	BS
19MAM23	Computer System Architecture	3	0	0	3	PC
19MAM24	Advanced Data Structures	3	0	0	3	PC
	PRACTICALS					
19MAM25	Calculus and Probability Lab	0	0	4	2	PC
19MAM26	Programming Paradigm Lab	0	0	4	2	PC
19MAM27	Advanced Data Structures Lab	0	0	4	2	PC
19FYEL21	English for Employability	0	0	2	1	EEC
	Total Credits				**21**	

Semester III

Course Code	Course Name	L	T	P	C	CAT
	THEORY					
19MAM31	Artificial Intelligence	3	0	0	3	PC
19MAM32	Theory of Computing	3	0	0	3	PC
19MAM33	Database Management Systems	3	0	0	3	PC
19MAM34	Predictive Analytics	3	0	0	3	BS
19MAM35	Human Computer Interaction	3	1	0	4	PC
	PRACTICALS					
19MAM36	Artificial Intelligence Lab	0	0	4	2	PC
19MAM37	Database Management Systems Lab	0	0	4	2	PC
19MAM38	Predictive Analytics Lab	0	0	4	2	PC
	Total Credits				**22**	

Semester IV

Course Code	Course Name	L	T	P	C	CAT
	THEORY					
19MAM41	Operations Research	3	0	0	3	BS
19MAM42	Machine Learning	3	0	0	3	PC
19MAM43	Design and Analysis of Algorithms	3	0	0	3	PC
19MAM44	Data Communications and Networking	3	0	0	3	PC
19MAM45	Operating Systems	3	0	0	3	PC
	PRACTICALS					
19MAM46	Machine Learning Lab	0	0	4	2	PC
19MAM47	Design and Analysis of Algorithms Lab	0	0	4	2	PC
19MAM48	Network Programming Lab	0	0	4	2	PC
	Total Credits				**21**	

Semester V

Course Code	Course Name	L	T	P	C	CAT
	THEORY					
19MAM51	Advanced Machine Learning	3	0	0	3	PC
19MAM52	Artificial Neural Networks	3	0	0	3	PC
19MAM53	Knowledge Based Systems	3	0	0	3	PC
19MAM54	AI Systems Engineering	3	0	0	3	PC
19MAM55	Distributed and Cloud Computing	3	0	0	3	PC
	PRACTICALS					
19MAM56	Advanced Machine Learning Lab	0	0	4	2	PC
19MAM57	Full Stack Web Development Lab	0	0	4	2	PC
19MAM58	Cloud Computing Lab	0	0	4	2	PC
19MAM59	Personality Development	0	0	2	1	EEC
	Total Credits				**22**	

Semester VI

Course Code	Course Name	L	T	P	C	CAT
	THEORY					
19MAM61	Intelligent Agents	3	0	0	3	PC
19MAM62	Deep Learning	3	0	0	3	PC
19MAM63	Information Retrieval and Web Search	3	0	0	3	PC
19MAM64	Big Data Analytics	3	0	0	3	PC
	Elective – I	3	0	0	3	PE
	PRACTICALS					
19MAM65	Deep Learning Lab	0	0	4	2	PC
19MAM66	Mobile Application Development Lab	0	0	4	2	PC
19MAM67	Big Data Analytics Lab	0	0	4	2	PC
19MAM68	Communication Skills	0	0	2	1	EEC
19MAM69	Hackathon	0	0	2	1	EEC
	Total Credits				**23**	

Semester VII

Course Code	Course Name	L	T	P	C	CAT
19MAM71	Project Work and Viva Voce-I	0	0	0	18	EEC
	Total Credits				**18**	

Semester VIII

Course Code	Course Name	L	T	P	C	CAT
	THEORY					
19MAM81	Graph Representation Learning	3	0	0	3	PC
19MAM82	Reinforcement Learning	3	0	2	4	PC
19MAM83	Meta-Heuristic Optimization Techniques	3	0	0	3	PC
	Elective II	3	0	0	3	PE
	Elective III	3	0	0	3	PE
	PRACTICALS					
19MAM84	Meta-Heuristic Optimization Lab	0	0	4	2	PC
	Elective Lab I	0	0	4	2	PE
	Elective Lab II	0	0	4	2	PE
	Total Credits				**22**	

Semester IX

Course Code	Course Name	L	T	P	C	CAT
	THEORY					
19MAM91	Computer Vision	3	0	0	3	PC
19MAM92	Cyber Threat Intelligence	3	0	0	3	PC
	Elective – IV	3	0	0	3	PE
	Elective -V	3	0	0	3	PE
	Elective -VI	3	0	0	3	PE
	PRACTICALS					
19MAM93	Computer Vision Lab	0	0	4	2	PC
19MAM94	Intelligent Cyber Security Lab	0	0	4	2	PC
19MAM95	Elective Lab-III	0	0	4	2	PE
	Total Credits				**21**	

Semester X

Course Code	Course Name	L	T	P	C	CAT
19MAM101	Project Work and Viva Voce- II	0	0	0	18	EEC
	Total Credits				**18**	
	Grand Total of Credits				**210**	

Professional Electives- AI & ML

Course Code	Course Name	L	T	P	C	CAT
19MAME01	Ethics in AI	3	0	0	3	PE
19MAME02	Healthcare Analytics	2	0	2	3	PE
19MAME03	Smart Applications	3	0	0	3	PE
19MAME04	Spatial Data Modelling and Analysis	3	0	0	3	PE
19MAME05	Augmented and Virtual Reality	3	0	0	3	PE
19MAME06	Medical Image Processing	3	0	0	3	PE
19MAME07	Natural Language Processing	3	0	0	3	PE
19MAME08	Probabilistic Graphical Models	2	0	2	3	PE
19MAME09	Cognitive Computing	3	0	0	3	PE
19MAME10	Recommender Systems	2	0	2	3	PE
19MAME11	Robotics and its Applications	3	0	0	3	PE
19MAME12	Conversational AI	3	0	0	3	PE
19MAME13	Game Theory	3	0	0	3	PE

Professional Electives-Information Technology

Course Code	Course Name	L	T	P	C	CAT
19MAME14	Agile Software Development	3	0	0	3	PE
19MAME15	SOA and Web Services	2	0	2	3	PE
19MAME16	Internet of Things	3	0	0	3	PE
19MAME17	Digital Signal and Image Processing	2	0	2	3	PE
19MAME18	Cyber Security	3	0	0	3	PE

Professional Electives -Economics, Finance and Management

Course Code	Course Name	L	T	P	C	CAT
19MAME19	Business Intelligence	3	0	0	3	PE

Professional Electives-Laboratory

Course Code	Course Name	L	T	P	C	CAT
19MAMEL01	Spatial Data Modelling and Analysis Laboratory	0	0	4	2	PE
19MAMEL02	Augmented and Virtual Reality Lab	0	0	4	2	PE
19MAMEL03	Natural Language Processing Lab	0	0	4	2	PE
19MAMEL04	Graph Analytics Lab	0	0	4	2	PE
19MAMEL05	Internet of Things Lab	0	0	4	2	PE
19MAMEL06	Cyber Security Lab	0	0	4	2	PE

One Credit Courses**

Course Code	Course Name	L	T	P	C	CAT
19MAMOC01	Econometrics and Machine Learning in Finance	1	0	0	1	EEC
19MAMOC02	Java Programming	0	0	2	1	EEC

****Over and above the CGPA**

19MAM11 - TECHNICAL ENGLISH

Contact Hours

L	T	P	C
2	0	0	2

PRE-REQUISITES

Consent of the Instructor

COURSE OUTCOMES

CO1: Given a social context compose appropriate dialogues using functional words, Construct Descriptive paragraphs using sequencing words and unity of thought

CO2: Given a communication context, categorize the barriers to communication and formulate solutions. Plan and present a 15-minute presentation on technical topic.

CO3: Given short conversations and monologues for listening, specify appropriate responses and construct a summary.

CO4: Interpret the given technical graphical representation and compose passages. Summarize and paraphrase technical text sin about 250 to 300 words.

CO5: Apply the rules of the grammar viz, word formation, nouns, adjectives, adverbs, tenses, concord, phrasal verbs and idioms and use appropriate patterns in the given sentence.

FOCUS ON LANGUAGE: GRAMMAR & VOCABULARY

Changing Words from one form to another - Word Formation: Prefixes & Suffixes - Synonyms and Antonyms – Idioms - Phrasal Verbs – Nouns-Compound Nouns & Noun Phrases - Gerunds & Infinitives – Subject-verb Agreement- Tenses – Adjectives - Expressions of Quantity - Degrees of Comparison – Relative Clause – Modal Verbs – Wh Questions – Sequence Words.

(6)

TECHNICAL COMMUNICATION

Importance of Technical Communication- General and Technical Communication –Objective & Characteristics of Technical Communication – Process of Communication - Levels of Communication – Flow of Communication –Visual Aids in Technical Communication - Barriers to Communication: Noise – Classification of Barriers –Non-verbal Communication: Kinesics – Proxemics- Chronemics- Correlating Verbal and Non-verbal Communication- Cultural Variations.

(4)

READING

Reading & Interpreting Ideas - Interpreting Graphics in Technical Writing – Intensive & Extensive Reading- Reading Comprehension – Techniques for Good Comprehension – Skimming & Scanning – Sequencing of Sentences- Reading text on different topics.

(4)

WRITING

Techniques for Good Writing - Right Words and Phrases – Sentences: Sentence Patterns- Salient Point of Sentence Construction - Paragraph Construction – Paragraph Patterns – Kinds of Paragraph – Writing a First Draft, Revising & Finalizing - Steps to Effective Précis Writing – Process Description – Dialogue Writing – Essays.

(6)

LISTENING

Meaning and Art of Listening-Importance of Listening & Empathy in Communication – Reasons for Poor Listening – Traits of a good listener – Listening modes – Short Dialogues and Conversation- Listening to monologues.

(4)

SPEAKING

Introducing oneself – Exchanging personal information – Asking for and giving information – Expressing likes and dislikes – Making requests – Agreeing and Refusing Requests – Complaining, apologizing – Giving excuses, instructions and suggestions- Describing positive and negative features, favourite snacks, vacation plans, technology, holidays, festivals, customs and special events - – Making comparisons – Talking about food – giving step by step instructions, travel advice - Achieving Confidence, Clarity & Fluency – Vocal Cues - Barriers to Speaking – Types of Speaking – Persuasive Speaking – Public Speaking - Effective Presentation Strategies – Planning - Outlining & Structuring – Nuances of Delivery – Controlling Nervousness & Stage Fright – Visual Aids in Presentation – Applications of MS Power Point.

(6)

Practical sessions based on the above syllabus

TOTAL HOURS: 30

TEXTBOOKS

1. Jack C Richerds, 'Interchange – 2', CUP, Fourth Edition, Chennai, 2015.
2. Meenakshi Raman, Sangeeta Sharma, 'Technical Communication – Principles and Practice', Oxford University Press, New Delhi, 2015.

EXTENSIVE READING

1. Abhijit Acharjee & Rakesh Ramamoorthy, 'Frontiers of Communication – An Anthology of Short Stories and Prose', CUP, 2018. (Only Essay Questions)

REFERENCES

1. Sudharshana N. P. and Savitha C, 'English for Technical Communication', CUP, 2016.
2. Sudharshana N. P. and Savitha C, 'English for Engineers', CUP, 2018
3. Ronald Carter, Michael Mc Carthy, 'Cambridge Grammar of English', Cambridge University Press, 2011.
4. Michael Mc Carthy and Felicity O'Dell, 'English Vocabulary in Use', Cambridge University Press, 2012.
5. Mark Ibbotson, 'Cambridge English for Engineering', Cambridge University Press, 2012.

19MAM12 - APPLIED ALGEBRA

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Gain knowledge in sequences and series to analyse and study their area of applications
CO2: Become familiar in linear algebra concepts for data analysis in economics
CO3: Identify and understand linear algebra techniques which are applied in AI and ML
CO4: To incorporate the concepts of numerical solutions of linear systems which are widely used in Computer Applications.
CO5: Apply difference equation concepts in data modelling.

SEQUENCES AND SERIES
Arithmetic, geometric, and harmonic sequences-Finite and infinite series. Convergence and divergence of infinite series-Simple examples-n^{th} term test for divergence and p-series convergence. Applications of series in financial mathematics**:** Simple and Compound Interest-Nominal and Effective Interest Rates-Continuous Compounding –Future Value and Present Value-Annuities- **Ordinary Annuity**: Future and Present Value, Annuity Payment, Principal Sum, Period and Interest Rate, Annuity Due, Deferred Annuity and Perpetuity.

(11)

VECTOR SPACES
Definition of vector spaces-linearly dependent and independent-subspaces-basis and dimension-of vector space-rank and nullity of linear transformation. Inner product, properties- Cauchy Schwarz-inequality, norm and its properties, introduction of orthogonal basis and Gram-Schmidt orthogonalization process.

(11)

MATRIX ALGEBRA
Eigen Values and Eigen Vectors: Eigenvalues and eigenvectors-Cayley-Hamilton theorem (without proof)-Diagonalization– Quadratic form reduction in three variables-applications.
Matrix factorization techniques-special matrices-permutation matrix (non-negative elements)-Hessenberg matrix-sparse matrix-sparse matrix-band width-Linear system of equations-Gauss elimination-Gauss Jordan-Inverse of a matrix-Gauss-seidal-iteration method. Application of Linear systems: A homogeneous system in economics- non homogenous system by inversion-Applications of Matrices in Input-Output Analysis in Economics.

(12)

DIFFERENCE EQUATIONS
Finite differences-operators and their interrelations-Solutions of finite difference equations with constant coefficients-Solution of first order equation (Iterative Method)-General method of solving first order difference equation-simple applications in economics.

(11)
TOTAL HOURS: 45

TEXTBOOKS

1. Srimanta pal and Subodh C. Bhunia, “Engineering Mathematics”, Oxford University Press India, 1stEdition, 2015. (Para I, Para IV).
2. Biswa Nath Datta, “Numerical Methods for Linear Control Systems Design and Analysis”, Elsevier Academic press, 2004. (Para III).
3. David. C. Lay, “Linear Algebra and its Applications”, Addision Wesley, 2003. (Para II).
4. Curtis F Gerald and Patrick O Wheatly, “Applied Numerical Analysis”, Pearson Education, 2002. (Para V).
5. Mehta B.C, and G.M.K. Madani, “Mathematics for Economists", Sultan Chand & Sons, New Delhi, 2006. (Para III)

REFERENCES

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, Eight Edition, John Wiley & Sons Asia Private Limited, 2008.
2. Grewal, B.S., “Higher Engineering Mathematics”, Fourth Edition, Khanna Publishers, 2007.
3. Piskunov, ‘Differential and Integral Calculus”, MIR Publisher Moscow, 1974.
4. Wylie C. R. & Barret L. C “Advanced Engineering Mathematics” Sixth Edition, McGraw Hill, New York, 1995.

19MAM13 - FUNDAMENTAL STATISTICAL METHODS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: To describe and discuss the key terminologies, concepts, statistical tools and techniques used in statistical analysis.
CO2: To calculate and apply measures of central tendency and measures of dispersion for grouped and ungrouped data.
CO3: To analyze probability and probability distributions and moments of random variables.
CO4: To understand basic concepts in sampling.
CO5: To analyze bivariate data using correlation and simple regression.

INTRODUCTION TO STATISTICS
Definition -Data –Qualitative and Quantitative – Measurement of Data –Nominal and Ordinal - Raw data and grouped data – Primary and Secondary Data – Methods of Collection –Classification of Data – Tabulation –Frequency Distribution and Various Diagrammatic and Graphical Representations of Data.

(8)

SUMMARY STATISTICS
Measures of Central Tendency: Arithmetic Mean, median, mode, geometric mean and harmonic mean Merits and demerits- Relationship between mean, median and mode-Relationship AM, GM and HM, computation of the measures for grouped and ungrouped data-Weighted arithmetic mean
Measures of Dispersion: Range, Mean Deviation and Standard Deviation – Coefficient of Variation and its Use- Quartiles and inter quartile range-Quintiles deciles and percentiles- Moving averages -Skewness and Kurtosis and their uses.

(10)

PROBABILITY
Deterministic and Random Experiments –Definition of Sample Space and Events- Classical and Axiomatic Definitions- Properties of Probability- Addition Theorem- Conditional Probability and Multiplication Theorem of Probability- Definition of Independent Events – Random Variables and their Probability Distributions-Discrete and Continuous Random Variables Probability Mass Function and Cumulative Distribution Functions -Definition – Mathematical Expectation-Mean and Variance – Mean and Variances of Linear Combination of Random Variables – Chebyshev's Theorem- -Important Discrete Distributions-Discrete Uniform Distribution, Binomial, Poisson, -Continuous Distributions: Probability Density Functions and Cumulative Probability Distributions-Normal Distribution and its Properties and Applications.

(12)

SAMPLING
Population and Sample- Sampling and its need –Sampling vs. Complete Enumeration –Parameter and Statistics-Probability Sampling and - Random **S**ampling**-** Simple Random Sampling, Lottery Method and

Random Number Table Method- Stratified Random Sampling- Sampling distribution and standard error of a statistic.

(8)

CORRELATION AND REGRESSION

Definition of correlation - Scatter plot –Karl Pearson's correlation coefficient its properties– Definition of Regression – Simple Regression-Regression of x on y and y on x.

(7)

TOTAL HOURS: 45

TEXTBOOK

1. S.C. Gupta, 'Fundamentals of Statistics', 7th and Enlarged Edition, Himalaya Publishing House, 2014.

REFERENCES

1. Ronald E.Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye , 'Probability and Statistics for Engineers and Scientists', Seventh Edition, Pearson Education, Inc. ,2002.
2. D M Levine T C Krehbiel and M L Berensen, 'Business Statistics: A First Course', Pearson Education, 2003.

19MAM14 - DATA STRUCTURES

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Understand the basics programming constructs of C language and write C programs to solve problems.
CO2: Recognize the representation of arrays, stacks, queues and linked list in memory and demonstrate its use in algorithms.
CO3: Solve computational problems using data structures such as arrays, stacks, queues and singly linked list.
CO4: Compare and use appropriate data structures in programming real world applications.
CO5: Learn and apply basic searching and sorting techniques in applications.

INTRODUCTION TO C
Overview of C - Basic data types - Identifier Names - Variables and Initialization – Constants - Operators – Expressions – Input/Output. **Control Statements:** Selection statements - Iteration statements - Branch statements - Expression statements. **Functions:** General form of a function - Accessing a function - Scope of a function – Passing Arguments to function - function prototype - Call by value - Call by reference - Recursion. **Arrays:** Single Dimensional arrays - Multi Dimensional arrays - Passing arrays to a function - Arrays and Strings. **Pointers:** Definition - Pointer type declaration - Pointer assignment - Pointer initialization - Pointer variables - Pointer operators –**Structures**: Defining and Accessing Structures.

(12)

BASIC CONCEPTS
Algorithm Specification - Data Abstraction - Primitive Data Structures - Iterative and Recursive algorithms - Performance Analysis: Space Complexity, Time Complexity, Asymptotic Notation.

(6)

ARRAYS
Array as an Abstract Data Type (ADT) – Implementation of One-Dimensional Array, Two Dimensional Arrays - Sparse Matrices-Applications- Representation of Multidimensional Arrays -String ADT.

(8)

STACKS AND QUEUES
Stack Primitive Operations- Array Representation and Implementation-Applications: Subroutine Handling, Recursion and Expression Processing. Queue Operations-Sequential Implementation - Circular Queues – Dequeues-Applications.

(8)

LINKED LISTS
Singly linked lists- Operations- Applications

(4)

SEARCHING AND SORTING

Linear Search and Binary Search-Selection Sort-Insertion Sort and Bubble Sort.

(7)

TOTAL HOURS: 45

TEXTBOOKS

1. Ellis Horowitz, Sartaj Sahni, Anderson-Freed, 'Fundamentals of Data Structures in C', University Press, Second Edition, 2008.
2. Yashavanth Kanetkar, 'Let Us C', BPB Publications, Fifteenth Edition, 2002. (Para I)

REFERENCES

1. Byron Gottfried, 'Schaum's Outline of Programming with C', McGraw-Hill Fourth edition 2018
2. Mark Allen Weiss, 'Data Structures and Algorithm Analysis in C', Pearson Edition, 2014.
3. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J.Augenstein, , 'Data structures using C & C++', Prentice Hall, 2012.
4. Krishnamoorthy R, 'Data Structures using C', Mc Graw-Hill Education Pvt. Ltd, 2010.

19MAM15 - THEORY OF PROGRAMMING LANGUAGES

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Identify the paradigms of programming languages.
CO2: Apply the concepts of imperative programming in program development
CO3: Analyze various components of object-oriented programming and apply them to real-world applications.
CO4: Understand the concepts of functional, logical and assembly language programming and relate them to apply in various programming languages.
CO5: Identify the suitable programming language and apply the concepts to solve the given real-world problems.

PROGRAM CONSTRUCTS AND THEIR TYPES
Introduction to program constructs: Program units and Program types.

(4)

IMPERATIVE PROGRAMMING
Programming Paradigms- Statements: Structured Programming- Syntax-Directed Control Flow. Design Considerations: Syntax. Special Cases in Loops. Invariants. Partial Correctness. Control flow. Types: Data Representation-Role of Types- Basic Types Arrays-Records-Sets-Pointers- String Tables-Types and Error Checking-Procedure Activations-Activation Records- Parameter-Passing Methods-Scope Rules for Names-Nested Scopes in Source Text-Lexical Scope.

(8)

OBJECT-ORIENTED PROGRAMMING
Groupings of Data and Operations-Constructs for Program Structuring-Information Hiding- Design with Modules-Modules and Defined Types-Class Declarations-Dynamic Allocation. Templates: Parameterized Types-Object-Oriented Programming-Object-Oriented Thinking- Inheritance-Derived Classes and Information Hiding-Objects in Smalltalk.

(8)

FUNCTIONAL PROGRAMMING
Elements of Functional Programming. Types: Values-Operations-Function Declarations. Approaches to Expression Evaluation-Lexical Scope-Type Checking- Functional Programming in a Typed Language-Exploring a List-Functions as First-Class Values- Functional Programming with Lists- Structure of Lists-List Manipulation.

(10)

LOGICAL PROGRAMMING
Connectives - Conditional and Bi-conditional statements -Statement formulae and Truth tables - Tautologies and Tautological Implications -Normal forms -Disjunctive and Conjunctive Normal Forms - The Theory of Inference for the Statement Calculus -Consistency of Premises - The Predicate Calculus -

Variables and Quantifiers - Special variable formulae involving Quantifiers- Theory of Inference for the Predicate Calculus.

(6)

Computing with Relations. Prolog: Data Structures-Programming Techniques-Control.

(3)

ASSEMBLY LANGUAGE PROGRAMMING

Introduction to 8085 Instructions: Data Transfer Operations-Arithmetic Operations-Logic Operations-Branch Operations-Writing Assembly Language Programs.

(6)

TOTAL HOURS: 45

TEXTBOOKS

1. Ravi Sethi, 'Programming languages: Concepts and Constructs', Second Edition, Addison Wesley 1995. (Para II-VI: Chapters 1, 3 to 11).
2. E.V. Krishnamoorthy, 'Introduction to Theory of Computation', East West Press, 1983. (Para I).
3. Ramesh Gaonkar, 'Microprocessor Architecture, Programming and Applications with the 8085', Sixth Edition, PENRAM International Publishing Pvt. Ltd. (Para VII)

REFERENCES

1. Ellis Horowitz, 'Fundamentals of Programming Languages', Springer-Verlag, 1983.
2. Terrence W Pratt, Marvin Zelkowitz, 'Programming Languages Design and Implementation', Pearson Education, Fourth edition, 2003.

19MAM16 - ALGEBRA AND STATISTICS LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
19MAM12, 19MAM13

ASSESSMENT: PRACTICALS

COURSE OUTCOMES
CO1: Solve problems in linear algebra using Scilab scripts and commands
CO2: Compute measures of central tendency and dispersion using Spreadsheets in built functions
CO3: Graphically represent statistical data using Spreadsheet tools
CO4: Analyze Bi-variate data using Spreadsheet's Data Analysis Tools
CO5: Develop skills in writing script files and analyze data using R and Spreadsheet's Data Analysis Pack

CONCEPTS TO BE COVERED

1. Scilab/R Fundamentals
2. Algebraic operations on matrices, Transpose of a matrix, Determinants, inverse of a matrix,
3. Solving System of linear equations and consistency,
4. Row reduced echelon form and normal form.
5. Eigen values, Eigen vectors, Rank of a matrix.
6. Solving algebraic and system of equations.
7. Estimating numerical values for given data by means of interpolation.
8. Perform data manipulation using spreadsheet.
9. Perform graphical and diagrammatic representation of statistical data, like bar diagram, pie, histogram and line diagram
10. Construct the pivotal tables and apply statistical functions to calculate the descriptive statistics
11. Practice the theory behind the descriptive statistics, like measures of central tendency, dispersion, skewness and kurtosis
12. Apply and implement the theory of probability in various applications
13. Simple probability and random sampling
14. Practicing the simple correlation and regression techniques.

Software/Tools: Scilab or R & Spreadsheet

REFERENCES

1. K.N.Berk and P.Carey, Data Analysis with Microsoft Excel, Brooks/Cole, USA,2010
2. Gilberto E.Urroz, Matrices and Linear Algebra with SCILAB, http://www.tf.uns.ac.rs/~omorr/radovan_omorjan_003_prII/s_examples/Scilab/Gilberto/scilab5a.pdf
3. Graeme Chandler and Stephen Roberts, Scilab Tutorials for Computational Science, http://paginapessoal.utfpr.edu.br/previero/calculo-numerico-ma64a-em41-e-em42/informacoes-da-disciplina/Scilab_Tutorials.pdf

19MAM17 - DATA STRUCTURES LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT: PRACTICALS

COURSE OUTCOMES

CO1: Solve the given problem by devising an algorithm and implementing it into a program.
CO2: Develop reusable and efficient solutions using functions, pointers and structures.
CO3: Write programs to perform operations on strings using library functions.
CO4: Implement stacks, queues and singly linked list using Arrays
CO5: Write programs to implement linear search, binary search and sorting algorithms like selection, insertion and bubble sort.

CONCEPTS TO BE COVERED

Basic Programming

1. Simple programs to understand the concepts of data types.
2. Writing algorithms and converting them to programs to get familiarity on using conditional, control and Iterative statements.
3. Programs on recursion
4. Programs on string manipulations
5. Programs on one- and two-dimensional arrays
6. Declaring and defining functions, passing arguments, calling functions
7. Simple programs using pointers-variables and expressions
8. Creating and accessing structures

Data Structures

1. Sparse and dense matrix operations using arrays.
2. Stack implementation and operations using arrays.
3. Queue implementation and operations using arrays.
4. Singly linked list implementation and operations using arrays
5. Programs on linear search and binary search
6. Programs on selection sort, insertion sort and bubble sort

REFERENCES

1. Yashavanth Kanetkar, ‘Let Us C’, BPB Publications, Fifteenth Edition, 2002.
2. Richard F. Gilberg and Behrouz A. Forouzan, ‘Data Structures- A Pseudocode Approach with C’, Cengage Learning, Second Edition, 2005.
3. Deitel H. M. and Deitel P. J., ‘C - How to Program’, Prentice-Hall, Fifth Edition, 2006.

19MAM18 - PYTHON PROGRAMMING LAB

Contact Hours

L	T	P	C
1	0	4	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: PRACTICALS

COURSE OUTCOMES
CO1: To write, test, and debug simple Python programs.
CO2: To implement Python programs using conditional, control and repetition statements.
CO3: Use functions and recursive functions for structuring Python programs.
CO4: Represent compound data using lists, tuples, dictionaries.
CO5: Read and write data from or to files in Python.

CONCEPTS TO BE COVERED

1. Naming conventions, basic operators, data types
2. Use of conditional, control and repetition statements
3. String operations and using string functions
4. Demonstrate use of Lists and Tuples
5. Demonstrate use of Dictionaries
6. Implement simple search and sort techniques
7. Demonstrate usage of basic regular expression
8. Demonstrate use of advanced regular expressions for data validation.
9. Implement linear data structures – arrays, stack and queue
10. Read and write into a file.
11. Create Comma Separate Files (CSV), Load CSV files into internal Data Structure
12. Demonstrate Exceptions in Python
13. Use of Python Libraries such as numpy, pandas, matplotlib, etc.

19FYEL11 - EMPLOYABILITY SKILLS

Contact Hours

L	T	P	C
0	0	2	1

COURSE OUTCOMES

CO1: Given strictly timed objective questions on logical reasoning and verbal ability solve within the given time.

CO2: For a given specific speaking task on topics like describing a picture, movie reviews, storytelling, and extempore generate ideas and speak confidently.

CO3: For a given social situation viz., greeting, thanking, congratulating, apologizing and giving directions, demonstrate command over conversations using appropriate functional expressions.

CO4: For a given 2 to5 minutes speaking activity like Extempore and Debate, produce language structures accurately and fluently. For a given technical topic, prepare a power point presentation for 15 minutes.

CO5: Given short conversations and monologues for listening, specify appropriate responses and construct a summary. Construct dialogues for a given social scenario and interpret the given graphic information and write creative paragraphs.

INTRODUCTION TO SPOKEN ENGLISH

Self-Introduction - Barriers to Speaking and Listening - Introduction to Spoken English, Greetings, Thanking - Apologizing, Congratulating - Giving Directions, Shopping – Role Play.

(6)

VOCABULARY

Activity based on newspaper articles - Word Building - A picture and a few words activity - Current Events.

(4)

VERBAL APTITUDE

Alphabet test – Alphabet Order, Alphabet Series - Letter Word Problem, Word Formation and Scramble - Series Completion –Para Jumbles- Synonyms and Antonyms- Types and Exercises- Sentence Completion –Types and Exercises.

(8)

READING AND PRESENTATION SKILLS

Reading Comprehension- Skimming and Scanning - Reading Prose – Bacon's Essays (Speaking Activity based on the essays) - Story Building- Extempore - Movie Reviews.

(4)

LSRW SKILLS

Speech Sounds - Word Vocabulary - Reading Comprehension - Listening Practice- I -Dialogue Writing - Conversational Exercise – I - Focus on Language - Creative Writing - Conversational Exercise – II - Listening Practice – II.

(8)

TOTAL HOURS: 30

19MAMLE01- PROFESSIONAL ENGLISH

Contact Hours

L	T	P	C
2	0	0	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES

CO1: Apply the rules of grammar namely Active and Passive voice, Direct and Indirect speech, Purpose and Function, Articles and Prepositions, Conjunction, Conditional sentences and use suitable patterns in a given sentence or passage.

CO2: Construct appropriate responses to greet, transfer, place the caller on hold, enquires, call backs, unintentional disconnects, interruptions, using suitable language and telephoning etiquettes. Given a business communication scenario construct a suitable strategy and action plan using specific negotiation tactics consistent with the objectives of the negotiator.

CO3: Given a communication context, specify the type and barriers to listening provide solutions and justify. For a given passage note the important points and summarize it.

CO4: Given a business communication scenario, compose a Business Letters, Memo, Emails, Reports, Technical Proposals, Instructions and Recommendation and checklist using appropriate language and format. For a given job requirement, prepare a job application letter with resume.

CO5: Generate valid points for and against the topic and present them with appropriate group behavior for a given HR topic and for any job requirement, plan and prepare for a 20 min HR mock interview.

FOCUS ON LANGUAGE: ENGLISH GRAMMAR & VOCABULARY

One Word Substitutes – Homophones – Homonyms – Eponyms – Direct Indirect Speech – Active Passive Voice – Conditional Sentences – Adverbs – Conjunctions – Prepositions – Articles – Relative Clause – Pronouns – Cause and Effect Expressions – Purpose and Function – Modals.

(6)

BUSINESS ENGLISH

Telephoning Skills: Understanding Telephone communication – Telephonic Conversations and Etiquettes - Handling Calls – Leaving a Message – Making Requests –Asking for and Giving Information – Giving Instructions - Negotiations: Types of Negotiation –Six Basic Steps of Negotiations – Informal and formal Negotiations.

(4)

READING

Summarizing – SQ3R Reading Technique – Note Making: Outline/Linear Method- Sentence Method – Schematic/Mapping Method – Understanding Discourse Coherence – Cloze Comprehension – Critical Reading: Creative and Critical Thinking- Reading proverbs, online advice forum.

(4)

WRITING

Letter Writing – Business Letters – Cover Letters – Resumes – Memos – Emails – Reports – Technical Proposals – Instructions & Recommendations – Technical Description – Checklist - Writing a paragraph – Writing a description of a person's past present and future, recent experiences, movie review, list of roles

– Writing a job application letter, Advice column list - Writing a guide book introduction – Writing about people response to a survey.

(6)

LISTENING

Stress and Intonation -Types of Listening – Barriers of Effective Listening – Listening for Generic Content and Specific Information - Listening & Note Taking – Intensive Listening - Listening to Descriptions - Listening to predicaments, call in radio show and excuses.

(4)

SPEAKING

Group Communication: Forms of Group Communication – Using Body Language in Group – Discussions – Group Discussions - Organizational GD – GD as a Part of Selection Process – Meetings – Conferences – Symposia & Seminars **–** Interviews: Objectives of Interviews – Types of Interviews – Job Interviews – Media Interviews – Press Conference - Describing abilities and Skills, acceptable and prohibited behaviour in different situations, Personality Traits, Countries, a predicament, Recent past events and experiences, movies and books – Giving Advice and suggestions- Making polite requests – Making invitations and excuses- Speculating about past and future events.

(6)

Practical sessions based on theory

TOTAL HOURS: 30

TEXTBOOKS

1. Jack C Richerds, ‘Interchange – 2’, Fourth Edition, Cambridge University Press, 2015.
2. Meenakshi Raman, Sangeeta Sharma, ‘Technical Communication – Principles and Practice’, Oxford University Press, 2015.

REFERENCES

1. Sudharshana N. P and Savitha C, ‘English for Technical Communication’, CUP, 2016.
2. Sudharshana N. P and Savitha C, ‘English for Engineers’, CUP, 2018.
3. Ronald Carter and Michael Mc Carthy, ‘Cambridge Grammar of English’, Cambridge University Press, 2011.
4. Michael Mc Carthy and Felicity O’Dell, ‘English Vocabulary in Use, Cambridge University Press, 2012.
5. Mark Ibbotson, ‘Cambridge English for Engineering’, Cambridge University Press, 2012.

19FY22F - BASIC FRENCH

Contact Hours

L	T	P	C
2	0	1	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Understand the basics of the Language
CO2: Write simple narration and description and speak to communicate idea.
CO3: Demonstrate confidence in Social Interactions.

INTRODUCTION

(2)

UNITÉ-1

Faire connaissance - inviter et répondre à une invitation - décrire les personnes- articles définis et indéfinis - genre etnombre des noms et des adjectifs- interrogation et négation - conjugaison du présent. Paris monuments et lieux publics - la vie de quatre parisiens de professions différentes.

(7)

UNITÉ-2
Exprimer l' ordre et l'obligation demander et commander - evaluer et apprécier- féliciter et remercier - articles partitifs -adjectifs démonstratifs et possessifs prépositions et adverbes de quantité et de l'imperatif verbes pronominaux - une région deFrance la Bourgogne - vie quotidienne à la compagne.

(6)

UNITÉ-3
Raconter et rapporter - donner son avis - se plaindre et réprimander - expliquer et justifier - pronoms compléments -futur proche - passé composé et imparfait. Plusieurs régions de France - différents univers sociaux.

(7)

UNITÉ-4
Demander l'autorisation - interdire - formuler des projects - discuter et débattre. Pronoms < en > et < y > - pronoms relatifs et superlatifs - conjugaison du futur - présent continu et passé récent.La vie administrative et régionale - problems economiques et écologiques - traditions et modernit.

(8)

Practical sessions based on theory

(15)

TOTAL HOURS: 45

TEXTBOOK

1. Le Nouveau Sans Frontières - Philippe Dominique, Jacky Girardet Michèle Verdelhan, Michel Verdelhan

REFERENCES

1. Dondo Modern French Course ---Mathurin Dondo.
2. Modern French Grammar---Margaret Lang and Isabelle Perez.

19FY22G - BASIC GERMAN

Contact Hours

L	T	P	C
2	0	1	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Understand the fundamental concepts of the Language
CO2: Write simple narration and description and speak to communicate idea.
CO3: Demonstrate confidence in Social Interactions.

EINFUHRUNG

BegrU ung - Name - Vorname - Familienname – Anrede **(5)**

THEMA

Hallo ! Wie geht's?

Begegnungen

Guten Tag, ich suche…,

Im Supermarkt

Arbeit und Freizeit

Familie und Haushalt **(7)**

GRAMMATIK-I

Position des Verbs : Aussage, W - Frage und

Ja/Nein - Frage; Artikel die der das.

W - Frage; Konjugation in Prasens;

Nominativ : bestimmter, unbestimmter und negative Artikel

Akkusativ : unbestimmterundnegativer Artikel

Adjektive : Akkusativ-Erganzung **(10)**

GRAMMATIK-II

Artikel als Pronomen Dative - Erganzung : Personalpronomen und Ortsangaben; Imperativ Modalverben; Ortsangaben; Richtungsangaben; Zeitangaben; Ordinalzahlen Possessiv - Artikel; trennbare und nicht trennbareVerben; Wechselprapositionen

(8)

Practical sessions based on theory

(15)

TOTAL HOURS: 45

TEXTBOOK

1. Studio d A1: Kurs - und Ubungsbuch (Deutsch alsFremdsprache) CornelsenVerlag.

REFERENCE

1. Tangarmaktuell1 : Kursbuch + Arbeitsbuch (Deutsch alsFremdsprache) Max HueberVerlag

19MAM21 - APPLIED CALCULUS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM12

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Become familiar in calculus tools to solve problems in optimization
CO2: Understand the concepts of integral calculus with a view towards applications.
CO3: Apply differential equations modeling.
CO4: Gain knowledge in Fourier series to analyze and study pattern recognition.
CO5: Get in-depth knowledge in numerical methods which are widely used in computer applications.

DIFFERENTIAL CALCULUS
Rate of change and limits-rules for finding limits-extensions of the limit concept-continuity-tangent lines-the derivative of function--related rates of change-extreme values of functions-the mean value theorem-first derivative test for local extreme values.

(7)

APPLICATIONS OF DIFFERENTIAL CALCULUS
Curvature–Evolutes–Envelopes–partial differentiation-Jacobians-Functions of several variables–-Hessian Matrix-Expansions and extreme values– Constrained extrema using Lagrange's multiplier method.

(8)

INTEGRAL CALCULUS
Integration–definition and geometrical meaning-double integrals as volumes-changing the order of integration, triple integrals in rectangular coordinates-applications to areas and volumes--compound interest. Special Functions: Beta and Gamma Functions- Double and triple integrals – Applications: Area – Volume.

(7)

FOURIER SERIES
Dirichlet's conditions-Full range series-Half range series-Complex form of series-Parseval's identity – Harmonic analysis.

(8)

ORDINARY DIFFERENTIAL EQUATIONS
Formation of differential equations-geometrical interpretation of ODE- Higher order differential equations with constant coefficients-Euler Cauchy Type-Applications in microeconomics.

(7)

NUMERICAL METHODS
Solution of Algebraic and transcendental Equations-Bisection Method and Newton Raphson Method--Real World Applications of Newton Raphson Method: Finding the Break Even Point of a Firm and finding the interest rates of Annuities -Interpolations-Newton's and Lagrange's method. Numerical solution of system of Equations. Numerical Integration-Numerical solution of ordinary differential equation of First order - RK method of order four-Milne Thomson method.

(8)

TOTAL HOURS: 45

TEXTBOOKS

1. Thomas & Finney, 'Calculus', Pearson Education, Ninth Edition, 2006. (Para I,II, & III).
2. Srimanta Pal and Subodh C. Bhunia, 'Engineering Mathematics', Oxford University Press India, First Edition, 2015. (Para IV, Para V).
3. Mehta B.C, and G.M.K. Madani, 'Mathematics for Economists', Sultan Chand & Sons, 2006. (Para II, Para III, Para V)
4. Kandasamy P.et.al., 'Numerical Methods', First Revised Edition, Tata McGraw Hill Publishing Company Ltd., 2008. (Para VI)

REFERENCES

1. Erwin Kreyszig, 'Advanced Engineering Mathematics', Eighth Edition, John Wiley & Sons Asia Private Limited., 2008.
2. Grewal, B.S., 'Higher Engineering Mathematics', Fourth Edition, Khanna Publishers, 2007.
3. Piskunov, 'Differential and Integral Calculus, MIR Publishers, Moscow 1974.
4. Wylie C. R. & Barret L. C, 'Advanced Engineering Mathematics', Sixth Edition, Mc Graw Hill, New York, 1995.
5. Steven C. Chapra and Raymond P. Canale, 'Numerical Methods for Engineers', Sixth Edition, McGraw Hill, 2002.

19MAM22 - PROBABILITY DISTRIBUTIONS AND APPLICATIONS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM13

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: To understand the properties and applications of advanced probability distribution.
CO2: To determine the moments and moment generating functions of important probability distributions and to impart knowledge on the functions of random variables.
CO3: To provide a good knowledge on the various methods of estimation of parameters.
CO4: To apply various tests of statistical hypothesis on a given statistical data.
CO5: Demonstrate the use and applications of Bayesian Analysis

PROBABILITY DISTRIBUTIONS
Discrete Random Variables: Geometric, negative binomial distributions and hyper geometric distributions. Continuous Probability Distributions: uniform, exponential, gamma, Beta, Chi-square log normal distributions and Weibull distributions and their properties.

(**8)**

FUNCTIONS OF RANDOM VARIABLES
Moments and Moment Generating functions of important distributions-Transformations of Variables and finding their distributions -method of direct transformation and method of moment generating functions- - Joint and Marginal Probability mass functions (for discrete) and density functions(for continuous). Conditional probability distributions-conditional mean and variance-Independence of random variables.

(10)

ESTIMATION
Estimation of parameters using method of moments- Maximum Likelihood Point Estimation(MLE) **–** Properties of estimators-Unbiasedness, minimum variance, efficience and sufficience-Mean Square Error-Asymptotic properties-consistency-Fisher Information and Cramer-Rao's Inequality – Interval Estimation.

(8)

SAMPLING AND TESTS OF HYPOTHESIS
Derivation of sampling distribution of mean and S^2- t-distribution and F-distribution-Central limit theorems- Test of significance – Basic concepts – null hypothesis – alternative hypothesis – level of significance – Standard error and its importance – steps in testing-One and two tailed tests-The use of p-values for Decision making – Large sample tests and Small sample tests for : Single sample: Testing on a single mean with variance known and variance unknown-Two samples-tests on means –One sample test on a single proportion-two sample tests of two proportions-Goodness of Fit tests, One and two sample tests concerning variances-Tests of independence for categorical data, tests for homogeneity.

(12)

BAYES THEOREM AND BAYESIAN STATISTICS
Partition of a sample space and Bayes Theorem (with proof)-Simple applications –Bayesian Concepts-Subjective Probability- Conditional Perspective-Bayesian Inferences-Prior and posterior distributions-Point Estimation Using the Posterior Distribution- Bayesian Interval Estimation-Bayes Estimates using

Decision Theory framework: Bayes estimate under squared error loss function and absolute error loss function.

(7)

Total: 45 Hours

TEXTBOOKS

1. S.C. Gupta, 'Fundamentals of Statistics', Seventh and Enlarged Edition, Himalaya Publishing House, 2014. (Para I-IV).
2. Ronald E.Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, 'Probability and Statistics for Engineers and Scientists', Seventh Edition, Pearson Education, Inc. , 2002. (Para V).

REFERENCES

1. S.C.Gupta and V.K.Kapoor, 'Fundamentals of Mathematical Statistics', Tenth Revised Edition, Sultan Chand & Sons, 2002.
2. Meyer, Paul L., 'Introductory Probability and Statistical Applications', Addison Wesley, Second Edition, 1970.
3. Anthony O'Hagan and Bryan R. Luce**, '**A Primer on Bayesian Statistics in Health Economics and Outcomes Research', MEDTAP International, Inc., 2003.
4. Michael Baron, 'Probability and Statistics for Computer Scientists', CRC Press, 2014.
5. Gianluca Bontempi, 'Handbook Statistical Foundations of Machine Learning', 2017

19MAM23 - COMPUTER SYSTEM ARCHITECTURE

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Understand the basic structure and operation of digital computer
CO2: Perform arithmetic operation on the various number systems and conversions among them
CO3: Apply Boolean algebra to solve logic functions.
CO4: Understand the basics of pipelining and I/O interfaces.
CO5: Evaluate the performance of memory systems.
CO6: Understand parallel processing architectures and GPUs.

BASIC COMPUTER SYSTEM
Introduction-Technologies for Building Processors and Memory – Performance – Instructions: Language of the Computer-Operations, Operands – Instruction Representation.

(4)

NUMBER SYSTEMS AND CODES
Decimal, Binary, Octal and Hexadecimal Systems - Number base conversions-BCD (8421) code - Gray code and conversion- ASCII code - Error detecting and correcting codes: parity bit, block parity, Hamming code.

(7)

BINARY ADDITION AND SUBTRACTION
1's, 2's, 9's, 10's, 15's, 16's Complement representation - 1's and 2's Complement subtraction - unsigned and signed numbers - BCD addition - 9's and 10's BCD subtraction - Binary Multiplication and Division.

(8)

BOOLEAN ALGEBRA AND LOGIC GATES
Laws of Boolean algebra - Basic theorem and properties - Boolean expression and function - Canonical and Standard forms - Minimization of Boolean expression - Karnaugh Map and Quine Mc-Cluskey Method- Basic logic gates and truth tables - universal gates implementation.

(8)

PROCESSOR AND CONTROL UNIT
Building a Data path – Control Implementation Scheme – Pipelining – Handling Data Hazards & Control Hazards – Exceptions.

(6)

MEMORY & I/O SYSTEMS
Memory Hierarchy – Memory Technologies – Cache Memory – Measuring and Improving Cache Performance – Virtual Memory: Page Faults, Translation Lookaside Buffer.

(5)

PARALLELISIM

Parallel Processing Challenges – Flynn‘s classification: SISD, MIMD, SIMD, SPMD, and Vector Architectures – Multi-Core Processors and other Shared Memory Multiprocessors – CUDA Basics-GPU versus CPU-Overview of GPU Architecture-GPU as a Co-processor.

(7)

TOTAL HOURS: 45

TEXTBOOKS

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014. (Para I,V,VI).
2. A.P.Godse and Dr. D.A. Godse, ‘Digital Electronics’, Technical Publications, Pune, 2008. (Para II, III, IV).
3. William Stallings, Computer Organization and Architecture – Designing for Performance, Tenth Edition, Pearson India Education Services Pvt. Ltd., 2017. (Para VII)

REFERENCES

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, ‘Computer Organization and Embedded Systems’, Sixth Edition, Tata McGraw Hill, 2012.
2. John P. Hayes, ‘Computer Architecture and Organization’, Third Edition, Tata McGraw Hill, 2012.

19MAM24 - ADVANCED DATA STRUCTURES

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM14

COURSE OUTCOMES
CO1: Implement the linked representation and traversal operations on singly and doubly linked list.
CO2: Gain knowledge on non-linear data structures such as trees and graphs and use them in programming applications.
CO3: Solve problems using data structures such as AVL search trees, heaps and m-way search trees.
CO4: Apply appropriate sorting techniques for solving real-time problems.
CO5: Understand the working principle of hashing and collision resolution techniques

LINKED LISTS
Doubly Linked List-Circular Linked List-Traversals-Applications: Addition of Polynomials, Sparse matrix Representation-Linked Stacks-Linked Queues.

(4)

TREES AND BINARY SEARCH TREES
Representation of Trees-Binary Trees: Representation, Operations, Traversals, -Threaded Binary Trees. Binary Search Trees: Searching, Insertion and Deletion of elements, Analysis-Forests.

(6)

GRAPHS
Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits- Euler Graphs -Hamiltonian Paths and Circuits. Elementary Graph Operations: Depth First Search, Breadth First Search, Connected Components, Spanning Trees. Minimum Cost Spanning Trees: Kruskal's Algorithm-Prim's Algorithm-Shortest Paths Algorithms: Single Source, Bellman Ford algorithm, All Pairs Shortest Paths.

(**8)**

HEAPS AND FORESTS
Priority Queues-Max Heap-Transforming a Forest into Binary Tree-Forest Traversals.

(5)

ADVANCED BINARY SEARCH TREES
AVL Trees: Balancing Trees- Searching, Insertion and Deletion of Elements-AVL Rotations, Analysis. Splay Trees: Notations, Analysis.

(7)

MULTIWAY TREES
m- Way Search Trees - B Trees - Red Black Trees - B+ Trees.

(5)

SORTING
Shell Sort-Quick Sort-Merge Sort-Heap Sort-Radix Sort-Time Complexity Analysis.

(6)

HASHING

Static Hashing: Hash Tables, Hash Functions-Dynamic Hashing-Collision Resolution: Open addressing - Linear Probing and Quadratic Probing.

(4)

TOTAL HOURS: 45

TEXTBOOK

1. Ellis Horowitz, Sartaj Sahni, Anderson-Freed, 'Fundamentals of Data Structures in C', University Press, Second Edition, 2008.

REFERENCES

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivert, Clifford Stein, 'Introduction to Algorithms', Second Edition, Prentice Hall of India, Publications, New Delhi, 2007.
2. Mark Allen Weiss, 'Data Structures and Algorithm Analysis in C++', Addison Wesley, 2014.
3. Anany Levitin, 'Introduction: The Design & Analysis of Algorithm', Pearson Education Inc., 2003.
4. S.K.Basu, 'Design Method & Analysis of Algorithm', PHI, 2005.

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19MAM25 - CALCULUS AND PROBABILITY LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES

19MAM21,19MAM22

COURSE OUTCOMES

CO1: Solve Differential Equations of first and second order using R commands

CO2: Understand properties of probability distributions using R programming and MS-Excel Tools

CO3: Calculate definite integrals numerically using Trapezoidal and Simpson's methods

CO4: To perform statistical hypothesis testing using R programming.

CO5: To analyze the data using Bayesian data analysis technique with the aid of R programming.

CONCEPTS TO BE COVERED

1. Extreme Value of functions-finding local extrema
2. Numerical differentiation based on Newton's formula, Lagrange's formula.
3. Functions of several variables–-Hessian matrix-Expansions and extreme values– Constrained extrema using Lagrange's multiplier method-applications
4. Numerical integration-Trapezoidal and Simpson's 1/3 rules.
5. Solution of Ordinary Differential Equations,
6. Discrete and Continuous probability distributions
7. Joint Probability Distributions
8. Estimation of population parameters
9. Statistical Hypothesis testing- Large Sample tests
10. Statistical Hypothesis testing – Small Sample tests
11. Bayesian Data Analysis

19MAM26 - PROGRAMMING PARADIGM LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

COURSE OUTCOMES

CO1: Understand the usage of different programming constructs of procedural programming
CO2: Apply the principles of object oriented programming to solve problems
CO3: Implement the concepts of logic programming and solve real world problems.
CO4: Develop solutions for problems using the concepts of functional programming paradigm.
CO5: Given a problem, develop solutions for it by applying all the four programming paradigms and compare it.

CONCEPTS TO BE COVERED

1. Illustrate concepts of :
   - Structured programming,
   - Data and control abstractions,
   - Programming with assertions (Programing with invariants)
2. Illustrate ideas of
   - Typing, expressions,
   - Pure functions,
   - Recursion,
   - Higher order functions,
   - Encapsulation,
   - Inheritance

   Using
     - Applicative programming and Python
     - Object oriented programming paradigm

REFERENCES

1. Harold Abelson, Gerald Jay Sussman and July Sussman, Structure and Interpretation of Computer Programs, 2nd edition, The MIT Press, 1996.
2. David A. Watt, Programming Language Concepts and Paradigms, Prentice-Hall, 1990.
3. Rajeev Sangal, Programming Paradigms in Lisp, McGraw Hill, 1991.
4. Ravi Sethi Concepts in Programming Languages

19MAM27 - ADVANCED DATA STRUCTURES LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
19MAM14

ASSESSMENT: PRACTICALS

COURSE OUTCOMES
CO1: Implement linked representation of linked list and its operations.
CO2: Implement and compare the complexities of various sorting algorithms including bubble sort, heap sort and quick sort.
CO3: Ability to define and apply tree data structures and binary search trees for real time applications.
CO4: Perform operations on graphs and heaps for real time problems.
CO5: Implement shortest path algorithms and hashing techniques for a given application.

CONCEPTS TO BE COVERED
1. Linked Lists Implementation -Singly linked lists, Doubly linked lists and Circular linked lists.
2. Programs on linked stacks.
3. Programs on linked queues.
4. Sorting algorithms-Bubble sort, Insertion sort, Selection sort, Quick sort, Heap sort and Radix sort.
5. Implementation of tree data structure and traversals
6. Applications of Binary search trees and its operations
7. Operations on AVL tree
8. B-Tree and its operations
9. Problems related to graphs and graph traversals
10. Construction of heap & its operation
11. Construction of minimum spanning tree algorithm.
12. Implementation of shortest path algorithms
13. Implementation of hashing techniques.

REFERENCES

1. Richard F. Gilbery, Behrouz A.Forouzan, ‘Data structures - A Pseudocode Approach with C’, Thomson Asia Pvt. Ltd. ,2002.
2. Yashwant Kanetkar, ‘Data Structures Through C’, Ninth Edition, BPB Publication, 2010.

19FYEL21 - ENGLISH FOR EMPLOYABILITY

Contact Hours

L	T	P	C
0	0	2	1

COURSE OUTCOMES

CO1: Given strictly timed objective questions on logical sequence of words, sequential order of things, comparison, and sentence correction, solve within the given time.

CO2: For a given specific speaking task on topics like Just a Minute Describing an object, book review and extempore generate ideas and speak confidently.

CO3: For a given social situation viz., Travel and Transport, complaining, giving instructions, advising and sympathizing, requesting and warning people, communicate effectively to peer using appropriate functional language.

CO4: For a given HR topic, generate valid points for and against the topic and present them with appropriate group behavior. For any job requirement, plan and prepare a 20 min HR mock interview.

CO5: For any job requirement, plan and prepare a 20 min HR mock interview.

SPEAKING SKILLS

Ice Breakers - Just a Minute - Book Reviews - Describing an object – Extempore – Paraphrasing.

(6)

FUNCTIONAL ENGLISH

Spoken English - Travel and Transport, Complaining - Giving Instructions, Advising and Sympathizing – Requesting and warning people.

(5)

VERBAL APTITUDE

Logical Sequence of Words- Exercises - Sequential Order of Things - Comparison Type Questions – Introduction and Exercises - Idioms and Phrases - Types and Exercises - Vocabulary through Mythology - One-word Substitutes, Word Power Exercises - Common Errors in English - Sentence Correction.

(7)

VOCABULARY IN CONTEXT

Activity based on newspaper articles - Vocabulary – Homophones and Homonyms - Reading Prose – Reading Comprehension Activity.

(4)

GROUP DISCUSSION AND INTERVIEW SKILLS

Professional Communication - Mock Group Discussion – Mock Interview – Telephoning Skills – Personality Development Activities.

(8)

Total: 30 Hours

19MAM31 - ARTIFICIAL INTELLIGENCE

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM24

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Apply various heuristic search strategies in optimal decision making
CO2: Understand uncertainty in real world situations.
CO3: Employ first order logic for building a knowledge base and demonstrate reasoning on this.
CO4: Express different planning strategies to deal with problems, describe and apply various knowledge representation techniques.
CO5: Review knowledge based Artificial Intelligent systems and approaches.

INTRODUCTION

Foundation of AI – Agents and Environments- Concept of Rationality – Nature of Environments – Structure of Agents.

(6)

PROBLEM SOLVING

Problem-Solving Agents and examples – Uninformed and Informed Search Strategies - Heuristic Functions - Local Search Algorithms and Optimization Problems – Local search in Continuous spaces – Searching with Nondeterministic actions and Partial Observations.

(12)

ADVERSARIAL SEARCH AND CONSTRAINT SATISFACTION PROBLEMS

Games - Optimal Decisions in Games - Alpha-Beta Pruning. Constraint Satisfaction Problems (CSP) - Backtracking Search for CSPs - Local Search for Constraint Satisfaction Problems - Structure of Problems.

(8)

KNOWLEDGE AND REASONING

Knowledge based Agents – The Wumpus World - Logic – Propositional Logic- Syntax and Semantics of First-Order Logic - Using First-Order Logic - Knowledge Engineering in First-Order Logic - Unification and Lifting - Forward Chaining – Backward Chaining - Resolution - Knowledge Representation.

(12)

PLANNING

Definition of classical planning - Algorithms for Planning as State-Space Search - Planning Graphs - Hierarchical Task Network Planning - Planning and Acting in Nondeterministic Domains – Multi agent Planning.

(7)

TOTAL HOURS: 45

TEXTBOOK

1. Stuart J Russell and Peter Norvig, “Artificial Intelligence- A Modern Approach”, Pearson Education Series, Third Edition, 2010. (Chapters 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)

REFERENCES

1. Dan W.Patterson "Introduction to AI and ES", Pearson Education, First Edition , 2007
2. Nilis J Nilsson “AI A new Synthesis” Morgan Kaufmann publishers, 1998

19MAM32 - THEORY OF COMPUTING

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Develop designs for different machine types: finite automata, pushdown automata.
CO2: Illustrate the mechanism of Turing machine and state its applications
CO3: Recognize partial recursive functions and its relationship to programs
CO4: Design different types of grammars and develop grammars to produce specific solutions.
CO5: Formulate methods to check the correctness of algorithms

FINITE STATE MACHINES
Deterministic finite state machine, Non-deterministic finite state machine, Pumping lemma for Regular grammar. Applications of Finite State Machines.

(8)

PUSH DOWN AUTOMATA
Deterministic push down automata. Recognizing context free grammars. Non deterministic push down automata and Ambiguous context free grammars. Applications of Push down Automata.

(8)

TURING MACHINES AND COMPUTABILITY
Turing Machines, recognizing Context sensitive grammars. Types of Turing machines, Halting problem. Effective procedure for algorithm and computability. Applications of Turing Machine.

(9)

FUNCTIONS
Basic functions and strategy set, Partial and Primitive recursive functions, Computability. McCarthy's formalism, Programs and Recursive functions.

(6)

PRODUCTIONS
Production system, Acceptors and Generators, Markov algorithms.

(8)

GRAMMARS
Rules, formalization, Ambiguity, Reduced Form, Derivation on Rule Tree, Chomsky hierarchy, Derivation graphs, Grammars and Compiler Design, Programming languages and Compilers, Sentential forms and Derivation trees, Parsing algorithms Stochastic grammars.

(8)

COMPUTATION

Approaches for checking correctness, Partial total correctness, Proof methods. Floyd Hoare Manna Inductive assertion. Functional methods.

(8)

TOTAL HOURS: 45

TEXTBOOKS

1. EV Krishnamoorthy, "Introduction to Theory of Computation", East West Press,1983. (Sections 2 to 5)
2. KLP Mishra, N.Chandrashekar “Theory of Computer Science -Automata, Languages and Computation” Second edition, PHI, 1998

REFERENCES

1. John E Hopcroft, Jeffrey D Ullman,"Introduction to Automata theory languages and computation", Addision Wesley 2006.
2. Michael Sipser "Introduction to the theory of computation" PWS Publishing, 2006.

19MAM33 - DATABASE MANAGEMENT SYSTEMS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Describe the purpose and architecture of database systems from the perspective of persistent storage of real world data.
CO2: Analyze the problem statement, construct the Entity Relationship model and map it into relational model by applying normalization.
CO3: Generate Relational Algebra, Relational Calculus and SQL statements to perform queries of real world applications
CO4: Evaluate the indexing techniques and choose the suitable technique by analyzing the given application
CO5: Determine the concurrency control and recovery mechanisms based on the criticality of the transaction

INTRODUCTION
Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Architecture, Database Users and Administrators.
Relational Model: Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Language, Relational operations.

(10)

DATABASE DESIGN
Database Design and the E-R Model, Overview of the Design Process, The Entity-Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity-Relationship Diagrams, Reduction to Relational Schemas, Extended E-R Features. Relational Database Design: Atomic Domains and First Normal Form, Decomposition Using Functional Dependencies, Functional-Dependency Theory.

(11)

INTRODUCTION TO SQL
Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Modification of the Database. **Intermediate SQL:** Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schemas, Authorization.
Advanced SQL: Accessing SQL from a Programming Language, Functions and Procedures, Triggers. **Formal Relational Query Languages:** The Relational Algebra, Tuple Relational Calculus, Domain Relational Calculus.

(10)

DATA STORAGE AND INDEXING

File Organization, Organization of Records in Files, Data-Dictionary Storage, Database Buffer. Indexing and Hashing: Basic Concepts, Ordered Indices, Overview of B+-Tree Index Files and Hashing Comparison of Ordered Indexing and Hashing, Bitmap Indices, Index Definition in SQL.

(7)

TRANSACTION, CONCURRENCY CONTROL AND RECOVERY

Concept, Simple Transaction Model, Atomicity and Durability, Isolation, Serializability, Isolation and Atomicity, Isolation Levels. Lock-based Concurrency Control, Time Stamp based Concurrency Control, Failure Classification, Recovery and Atomicity.

(7)

TOTAL HOURS: 45

TEXTBOOK

1. Abraham Silberschatz, Henry F.Korth and S.Sudarshan, "Database System Concepts", Sixth Edition, McGraw Hill, 2010.

REFERENCES

1. Ramez Elmasri, Shamkant B. Navathe Durvasula, V.L.N. Somayajulu, Shyam K. Gupta, "Fundamentals of Database Systems", Fourth Edition, Pearson Education, 2006.
2. Christopher Allen, Simon Chatwin, Catherine A. Creary, "Introduction to Relational Databases and SQL Programming", Tata McGraw-Hill,2003.

19MAM34 - PREDICTIVE ANALYTICS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM13, 19MAM22

COURSE OUTCOMES
CO1: Analyze time series data and apply it to forecast the future.
CO2: Formulate and compute multiple linear regression model and understand its properties.
CO3: Classify objects into different groups using discriminant function, logistic regression equation.
CO4: Identify underlying factors in multivariate data sets using principal component analysis.
CO5: Understand the terminology of factor analysis, factor rotation and interpret factor loadings using R programming.

MULTIPLE REGRESSION ANALYSIS (MLR)
Variables in Multivariate Data-Mean Vector, Covariance and Correlation Matrices and their properties-Estimation of missing values. Multiple Linear Regression Equation and Polynomial Regression Models-Estimation of the coefficients using method of least squares–Linear Regression using Matrices-Properties of Least Squares-Inferences in Multiple Linear Regression: ANOVA and testing the partial regression coefficients- Interpretation of R^2-Standardized Regression Coefficient and its interpretation-Inclusion of categorical or indicator variables in MLR –Multi-collinearity problem-Stepwise Regression.

(10)

TIME SERIES FORECASTING
Regression Model for forecasting-Forecasting Time Series data with Seasonal Variation-Auto-Regressive(AR) Models- AR Model Identification: ACF and PACF, Moving Average -MA(q)) and ARMA(p,q) Models-Auto-Regressive Integrated Moving Average (ARIMA) Process-Dickey Fuller Test-Augmented Dickey-Fuller Test-Transforming Non Stationary Process to Stationary Process using Differencing-ARIMA(p,d,q) model building-Ljung-box test for Auto-Correlations-Power of Forecasting: Theil's Coefficient.

(12)

DISCRIMINATION AND CLASSIFICATION
Discriminant Function Analysis- Fisher's discriminant function –Fitting discriminant functions using R and interpreting the results. Logistic Regression: Logistic Model-Definitions of Odds and Logit-Estimation of the logistic regression coefficients-Making Predictions-Multiple Logistic Regression-Fitting logistic regression equation using R and interpreting the results.

(9)

PRINCIPAL COMPONENT ANALYSIS
Data Reduction Techniques-Definition of Population Principal Components –Principal Components obtained by Standardized variables -Rules to retain number of Principal Components using Scree Plot-Graphing the Principal Components-Testing the equal correlation structure-Geometric and Algebraic bases of Principal Components.

(7)

FACTOR ANALYSIS

Factor Analysis -Definitions-The Orthogonal Factor Model-Its Covariance Structure- Estimation of loadings and communalities-Principal component method and Principal factor method-Factor Loadings and Interpretations- Rotation- Orthogonal and Oblique rotation-Exploratory and Confirmatory Factor Analysis- Estimation of PCA and FA using R.

(7)

TOTAL HOURS: 45

TEXTBOOKS

1. Alvin C.Rencher, William F. Christensen "Methods of Multivariate Analysis",3rd Edition, Wiley Inter-science, 2012
2. Dinesh Kumar U, " Business Analytics", Wiley, First Edition, 2017
3. Richard A.Johnsonand Dean W.Wichern, " Applied Multivariate Statistical Analysis", 6th Edition, Pearson Prentice Hall, 2007.

REFERENCES

1. R.E.Walpole, R.H.Myers,S.L.Myers and K.Ye, "Probability and Statistics for Engineers and Scientists", 9th Edition, Prentice Hal, 2012.
2. Joseph F. Hair Jr., William C. Black, Barry J.Babin and Rolph E.Anderson, "Multivariate Data Analysis", 7th Edition, Pearson, 2010.
3. G.James,D.Witten, T.Hastie and R.Tibshirani, "An Introduction to Statistical Learning with Applications in R", Springer, 2015.

19MAM35 - HUMAN COMPUTER INTERACTION

Contact Hours

L	T	P	C
3	1	0	4

PRE-REQUISITES
Consent of instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Learn the foundations of Human Computer Interaction (HCI)
CO2: Be familiar with the design technologies for individuals and persons with disabilities
CO3: Be familiar with models and theories of HCI
CO4: Develop an understanding of the intricacies of mobile HCI
CO5: Develop an understanding of the intricacies of web HCI

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

(9)

DESIGN & SOFTWARE PROCESS
Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.

(9)

MODELS AND THEORIES
Cognitive models –Socio-Organizational issues and stakeholder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW.

(9)

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

(9)

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

(9)

TOTAL HOURS: 45

TEXTBOOKS

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, Third Edition, Pearson Education, 2004.
2. Brian Fling, “Mobile Design and Development”, First Edition, O‟Reilly Media Inc., 2009.
3. Bill Scott and Theresa Neil, “Designing Web Interfaces”, First Edition, O‟Reilly, 2009.

19MAM36 - ARTIFICIAL INTELLIGENCE LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Design and implement heuristic search procedures
CO2: Develop solutions for constraint satisfaction problem
CO3: Design and implement solutions for classical Artificial Intelligence problems
CO4: Design and implement knowledge-based system
CO5: Become familiar with use of Artificial Intelligence tools.

CONCEPTS TO BE COVERED

1. Implementing state space search algorithms for solving puzzle problems.
    a. A* Search
    b. Hill-climbing Search.
2. Implementation of Min-Max Search Procedure with alpha beta pruning for finding the solutions of games.
3. Implementation of Constraint Satisfaction Problem for solving Crypt-arithmetic.
4. Implementation of Unification algorithm by considering Resolution concept.
5. Solve the classical Water Jug problem.
6. Solve the classical Monkey Banana problem.
7. Solve the classical Blocks World problem.
8. Develop a knowledge base system/ expert system consisting of facts and rules about some specialized knowledge domain of your choice.
9. Designing a Chatbot application
10. Development of programs for simulation of computer games like: Tic-Tac-Toe, N-queens Problems, travelling salesman problem, Chess, etc.

Softwares: Use of PROLOG/LISP, CLIPS or any open source framework

19MMA37 - DATABASE MANAGEMENT SYSTEMS LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Design the conceptual data model as Entity Relationship diagram and create the database using DDL statements for a given application.
CO2: Formulate simple DML SQL queries to retrieve the required data for real world applications.
CO3: Generate DML queries with Subqueries, Joins, Group By, Order By and Aggregate functions to filter and aggregate the data of the real world applications.
CO4: Construct reusable PL/SQL blocks with Functions, Procedures, Packages, Triggers, Exception Handling, and Cursors as required by OLTP applications.
CO5: Develop a database project by constructing the ER model, creating Tables and generating SQL and PL/SQL blocks using RDBMS platform.

CONCEPTS TO BE COVERED
1. Designing a database for an application and representing it through ER diagram
2. Creating and managing tables
3. Basic SQL SELECT statements
4. Restricting and sorting data
5. Single row functions
6. Displaying data from multiple tables
7. Aggregating data using Group function - Group By
8. Subqueries
9. Views, Sequence, Index, Synonym
10. SET operators, Date and Time functions
11. PL / SQL Programs
12. Exception Handling, Cursors, Functions, Procedures, Package, Triggers

Softwares: MySQL/Oracle

19MAM38 - PREDICTIVE ANALYTICS LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Use R software to analyze multivariate data using multiple linear regression, discriminant function, logistic regression equation models and cluster analysis tools.
CO2: Using R software to analyze Time Series Models
CO3: Identify underlying factors in multivariate data by applying factor analysis and principal component analysis models using R software packages.
CO4: Use R software to retain the components and loading of the Principal Components.
CO5: Use R to verify the data and to estimate the parameters of a factor model.

CONCEPTS TO BE COVERED

1. Reading and plotting Multivariate Data–Matrix scatter plot and Scatter plot with the data points labeled by their group.
2. Calculating summary statistics for Multivariate Data-Means and variances per group, Between-groups Variance and within-groups variance for a variable.
3. Calculating Covariances, Correlations and Standardizing Multivariate data fitting Multiple Regression Equation using MS-Excel and interpreting the output.
4. Writing Script files in R for Fitting Multiple Regression Equation: Summary, extracting β coefficients, Covariance matrix, standard errors, residuals and fitted values and plotting, Normal Probability Plot of residuals, Predictions-Compare the results using lm command.
5. Stepwise regression: forward, backward and stepwise.
6. Differencing a Time Series, selecting a Candidate ARIMA Model, Forecasting using ARIMA Model.
7. Fitting logistic regression equation: Prediction, goodness of fit and Plotting ROC Curve.
8. Discriminant function analysis and loadings for the discriminant functions.
9. Principal component Analysis : screen plot to decide on the number of components to retain and loadings for the PCs and Scatter Plots for PCs.
10. Factor Analysis using R

19MAM41 - OPERATIONS RESEARCH

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Solve Linear Programming, Transportation and Assignment based problems.
CO2: Discuss the elementary Inventory models, Price break models and Safety stock problems.
CO3: Solve Job sequencing and replacement problems.
CO4: Categorize the Queuing models and also simulate the problems using Monte - Carlo Technique.
CO5: Analyze the network models using CPM and PERT.

LINEAR PROGRAMMING
Linear programming problem - canonical and standard forms - formulation - graphical solution – simplex method-Big M method using artificial variables- **Transportation model** – Initial Basic Feasible Solution using Northwest Corner method, Matrix Minima method and Vogels approximation method – Optimal solution by Modified Distribution Method-Unbalanced Transportation problems and Degeneracy - **Assignment model**-Solution by using Hungarian method.

(12)

SEQUENCING AND REPLACEMENT
Sequencing: Basic assumptions – Johnson's procedure for Sequencing of: i) n jobs on 2 machines ii) n jobs in 3 machines and iii) n jobs on m machines. **Replacement:** Need for replacement of equipments - failure mechanism of items - Replacement policy - Replacement of items that deteriorates gradually - Replacement of items that fail suddenly.

(7)

INVENTORY
Need for the inventory - Costs involved in inventory - Concepts of average inventory, economic order quantity - Deterministic model: Fixed ordering quantity models - EOQ model with uniform demand, finite and infinite replacement with or without shortages -EOQ with one price break. Inventory control - Buffer stock - Determination of optimum buffer stock - EOQ system of ordering - Multi item order model - ABC analysis.

(9)

QUEUING THEORY
Queuing system characteristics-Describing a queuing system by input pattern, service mechanism, queue discipline and customer behaviour- Steady, transient and explosive states in queuing systems-Designation of queue and symbols used in queuing models- M/M/1 (∞/FIFO) model-Steady State solutions-Finite Queue Length Model: (M / M / 1) : (N/FIFO).

(8)

PERT and CPM NETWORKS

Activities and events-Rules for forming a Network- Critical Path Method(CPM) for computing project completion time- network – Time estimation in CPM-Project Cost Analysis- critical path -Crashing-Least cost schedule algorithm- PERT - Network – Difference between PERT and CPM-Time estimates in PERT-Critical Path estimation - Probability of meeting a scheduled date of completion of the project.

(9)

TOTAL HOURS: 45

TEXTBOOK

1. Hamdy, A Taha, "Operations Research - An introduction", Pearson Education India, 2004.

REFERENCES

1. Rama Murthy P. Operations Research, New Age International, Second Edition, 2007.
2. S. D. Sharma "Operations Research ", Kedar Nath Ram Nath & Co publishers, 10th edition, 1995.
3. Kanti Swarup, P.K. Gupta, Mani Mohan, "Operations Research", Sultan Chand & Sons, 2001.
4. Hillier & Lieberman, "Operations Research - An Introduction", Tata McGraw-Hill, 2004

19MAM42 - MACHINE LEARNING

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM13, 19MAM22

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Recognize fundamental issues and challenges of machine learning: data, model selection, model complexity, supervised and unsupervised learning.
CO2: Apply Decision trees and Artificial Neural Networks in classification
CO3: Distinguish the strength and weakness of Bayesian learning.
CO4: Analyze and use Instance based learning and reinforcement learning in real time problems.
CO5: Learn association rules and clustering methods and apply to derive insights from data.

INTRODUCTION
Basics of Machine Learning-Examples of Machine Learning Applications-Designing a Learning System.

(3)

CONCEPT LEARNING AND GENERAL TO SPECIFIC ORDERING

Concept Learning Task- Concept Learning as Search- Find-S- Version Space and Candidate Eliminate Algorithm-Inductive bias.

(5)

DECISION TREE LEARNING
Decision tree representation, Decision tree Learning Algorithm- Inductive bias-Issues in Decision Tree learning.

(6)

ARTIFICIAL NEURAL NETWORKS
Introduction- Neural Network Representations- Perceptron- Multi-layer Networks and Back Propagation Algorithm- Remarks on the Back propagation Algorithm- Face Recognition Example.

EVALUATING HYPOTHESIS
Motivation, Estimating Hypothesis Accuracy, Basis of Sampling Theory- Difference in Error of Two Hypothesis- Comparing Learning Algorithms

(8)

BAYESIAN LEARNING
Bayes Theorem - Bayes theorem and Concept Learning- Maximum Likelihood and Least Square Error Hypothesis- Bayes Optimal Classifier- Naive Bayes Classifier-Bayesian Belief Networks- EM Algorithm.

(8)

INSTANCE BASED LEARNING

k-Nearest Neighbour Learning, locally weighted Regression- Radial Basis Functions- Case based Reasoning. **Reinforcement Learning:** The learning task – Non-deterministic Rewards and Actions - Relationship to Dynamic Programming.

(8)

UNSUPERVISED LEARNING

Introduction-k-means Clustering-Hierarchical Clustering. Association Rules - Apriori Algorithm.

(7)

TOTAL HOURS: 45

TEXTBOOKS

1. Tom M Mitchell, "Machine Learning", Indian Edition, McGraw Hill, 2013.
2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, 3rd Edition, 2014. (First and Last Para).
3. Jaiwei Han, Micheline Kamber Data Mining-concepts and techniques, 2/e, Morgan Kaufmann Publishers, San Francisco,2006. (Last Para)

REFERENCES

1. Bishop, C. Pattern Recognition and Machine Learning. Berlin: Springer-Verlag, 2006.
2. Stephen Marsland, Machine Learning: An Algorithmic Perspective, Chapman and Hall,2014.

19MAM43 - DESIGN AND ANALYSIS OF ALGORITHMS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM14, 19MAM24

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Able to apply divide and conquer, greedy methods in problem solving
CO2: Able to use dynamic programming in real time problems and derive efficient solutions.
CO3: Able to understand the concepts of backtracking and branch-bound techniques.
CO4: Able to differentiate between NP, NP hard and NP Complete problems.
CO5: Able to analyze the efficiency of different algorithm design techniques and their proper usage in application problems.

INTRODUCTION
Fundamentals of algorithmic problem solving – Method of specifying an algorithm – proving the correctness – Analyzing an algorithm - Asymptotic Notations.

(5)

DIVIDE AND CONQUER
General Method- Binary Search - Finding the Maximum and Minimum- Merge Sort - Quick Sort - Strassen's Matrix Multiplication.

GREEDY METHOD
General Method - Knapsack Problem - Tree Vertex Splitting - Minimum-cost spanning trees- Single Source Shortest Paths.

(7)

DYNAMIC PROGRAMMING
General Method - Multistage Graphs - All-Pairs Shortest Paths - Single Source Shortest Path - Traveling Salesperson Problem.

(7)

BACKTRACKING
General Method - 8 Queens Problem – Sum of Subsets- Graph Coloring -Hamiltonian Cycles.

(7)

BRANCH AND BOUND
General Method - 0/1 Knapsack Problem - Traveling Salesperson Problem.

(5)

NP-HARD, NP-COMPLETE CLASSES
Basic concepts – Non-deterministic algorithms – Satisfiability Problem – NP-hard and NP-complete Problems.

(7)

TOTAL HOURS: 45

TEXTBOOK

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, “Fundamental of Computer Algorithms”, Galgotia Publications, 1998.

REFERENCES

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivert, Clifford Stein “Introduction to Algorithms”, Second Edition, Prentice Hall of India, Publications, New Delhi, 2007.
2. Anany Levitin, “Introduction: The Design & Analysis of Algorithm”, Pearson Education Inc., 2003.
3. Michael T.Goodrich, Roberto Tamassia, “Algorithm Design, Foundations, Analysis and Internet Examples”, Wiley, 2011.
4. Jon Kleinberg and Eve Tardos, “Algorithm Design”, Pearson Education, 2012.

19MAM44 - DATA COMMUNICATIONS AND NETWORKING

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Enumerate the layers of the OSI model and TCP/IP and compare the models.
CO2: Describe the relationship between data and signals, and distinguish among their types, behavior, properties, characterization, and transmission.
CO3: Given an inter-network topology configuration, can demonstrate how a packet reaches the destination.
CO4: Explain the services offered by each layer of TCP/IP protocol suite and the role of each protocol.
CO5: Given an application, can explain the role of the protocols involved.

INTRODUCTION
Data Communications – Networks – The Internet – Protocols and Standards – OSI Model – TCP/IP Protocol Suite – Addressing.

(9)

PHYSICAL LAYER AND MEDIA
Data and Signals – Digital Transmission: Digital to Digital Conversion – Analog to Digital Conversion – Transmission Modes – Analog Transmission: Digital -to -Analog Conversion – Multiplexing Techniques.

(10)

DATA LINK CONTROL
Framing – Flow and Error Control – Protocols – Noiseless Channels – Noisy Channels. Multiple Access: Random Access Protocols – Ethernet - IEEE 802.11.

(7)

NETWORK LAYER
Switching – Packet switching at Network Layer – Network layer Services – Issues – IP Addresses – Delivery and Forwarding of Packets – Internet Protocol IPv4 - Address Resolution Protocol – Internet Control Message Protocol.

(9)

HIGHER LAYERS
Transport Layer: Services – User Datagram Protocol: User Datagram – UDP services – Transmission Control Protocol: TCP services – Features – Segment – TCP connection Management.
Application Layer: DNS – Worldwide Web.

(10)
TOTAL HOURS: 45

TEXTBOOKS

1. Behrouz A Forouzan, "Data Communications and Networking", Tata McGrawHill, 5th Edition, 2017. (Para 1-III)
2. Behrouz A Forouzan, "TCP/ IP Protocol Suite", Tata McGraw Hill, 2010. (Para IV-V)

REFERENCES

1. Kevin Fall R and Richard Stevens W, "TCP/IP Illustrated, Volume 1: The Protocols", Addison-Wesley, 2011.
2. James F Kurose and Keith Ross, "Computer Networking: A Top-Down Approach", Pearson Addison-Wesley, 2012.
3. Douglas Comer, "Internetworking with TCP/IP", Prentice Hall, 2013. 4. William Stallings, "Data and Computer Communications", Pearson, 2013.

19MAM45 - OPERATING SYSTEMS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Demonstrate the structure of operating system, batch programming, system calls and virtual machines.
CO2: Demonstration of Kernel Management specific to concurrent process for Inter Process Communication systems.
CO3: Estimate system performance through scheduling algorithms - FIFO, round robin, priority, shortest job first.
CO4: Recognize memory allocation and deallocation for both static and dynamic storage.
CO5: Design and develop a new simple File System using Disk and File System Management

INTRODUCTION

Abstract view of an Operating system - Extended view of resource manager - Overview: Simple Batch system - Multi programmed batch systems - Time Sharing Systems - Parallel Systems - distributed systems - Real time systems - System structure: IO structure- memory- CPU-Kernels and microkernels - Dual-mode operation - operating - system services - system calls - Structure of Operating system- Various components of Operating system.

(9)

PROCESS MANAGEMENT

Process Concepts - Process Creation - Process Termination - Process States - Process Description - Process Control - Relationship between process and threads - Thread State - Thread Scheduling- Thread Synchronization-Multithreading model - Concurrent Process -process synchronization: critical section problem - Mutual Exclusion - Dekker's algorithm -synchronization hardware - semaphore - classical problem of ynchronization - critical regions - monitors - atomic transaction - race condition. Deadlock characterization - handling deadlocks - prevention - avoidance - detection and recovery - combined approach.

(10)

PROCESSOR MANAGEMENT

Basic Concepts - Scheduling Criteria – Pre-emptive versus non-preemptive scheduling - Scheduling algorithms: FIFO - Shortest job first, priority, round robin, multi-level queue - Multi level feedback queue - multiprocessor scheduling.

(9)

MEMORY MANAGEMENT

Basic Concepts - Logical versus Physical address - Swapping - Fixed Partition and Dynamic Partition - Simple Paging - Multi Level Paging - Inverted Paging – Paging algorithms-Simple segmentation- Virtual Memory - Demand Paging - Thrashing-Working Set Model -Demand Segmentation.

(9)

I/O AND FILE MANAGEMENT

I/O: hardware - Application I/O interface - Logical Structure of I/O Functions -I/O Buffering - Disk I/O - Disk Scheduling. File Management: File Concepts - Access methods - Directory Structure - File System Structure - Allocation methods - Free Space Management.

CASE STUDIES

Mobile Operating System-Cloud and IoT Operating Systems.

(8)

TOTAL HOURS: 45

TEXTBOOKS

1. Abraham Silberschatz. A, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", John Wiley, 2013.
2. William Stallings, "Operating Systems: Internals and Design Principles", Prentice-Hall, Ninth edition, 2018.

REFERENCES

1. H.M.Dietel, "An Introduction to Operating Systems", Addison Wesley, 2nd Edition,2007.
2. Andrew S. Tanenbaum, "Modern Operating Systems", Prentice Hall of India Pvt. Ltd, 2008.

19MAM46 - MACHINE LEARNING LAB

Contact Hours

L	T	P	C
0	0	4	2

PREREQUISITES
19MAM18

COURSE OUTCOMES
CO1: Able to prepare the data for machine learning using data pre-processing and dimension reduction techniques.
CO2: Able to build regression and classification models using benchmark datasets and give insights.
CO3: Able to evaluate the performance of models using different performance measures.
CO4: Able to use clustering techniques to group data and analyse the clusters.
CO5: Able to design and develop prediction systems by choosing appropriate machine learning algorithms on real-time datasets.

CONCEPTS TO BE COVERED

1. Perform descriptive analysis on different types of datasets
2. Apply pre-processing techniques on the dataset.
3. Build Regression models to predict future values for datasets like rainfall, earthquake etc.
4. Build Classification models and infer the results
    a. Decision tree classifier
    b. Naïve Bayes Classifier
    c. k-Nearest Neighbor Classifier
5. Apply cross validation techniques and evaluate the models using various performance metrics
6. Implement Perceptron and Artificial Neural Network for simple problems
7. Implement the non-parametric Locally Weighted Regression algorithm to fit data points.
8. Clustering
    a. Implement K-Means Clustering
    b. Implement Hierarchical clustering
9. Use market basket dataset and mine association rules using Apriori algorithm.
10. Build a complete Machine Learning pipeline with data visualization capabilities for a given prediction problem.

Note: *Benchmark datasets may be downloaded from UCI machine learning repository, Kaggle etc for each of the above problems.*

19MAM47 - DESIGN AND ANALYSIS OF ALGORITHMS LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
19MAM17,19MAM27

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Ability to analyze the efficiency of different algorithm design techniques and their proper usage in application problems.
CO2: Implementing string matching and network flow algorithms.
CO3: Able to apply data structure concepts in any applications of the dynamic programming
CO4: Implement the design technique of backtracking in application to analyze the types of problem solved using backtracking
CO5: Skill to compare, contrast, and understand the choice of various design techniques to solve a given problem.

CONCEPTS TO BE COVERED

1. Problem using closest pair algorithm
2. Prim's minimum cost spanning tree
3. Kruskal's minimum cost spanning tree using min heap data structure, union and find operation
4. Problem related to greedy methods
5. Applications of dynamic programming
6. Application of all pairs shortest path problem
7. Application of graph coloring using backtracking
8. Applications of branch and bound technique
9. String matching algorithms

19MAM48 - NETWORK PROGRAMMING LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
19MAM14

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Understand key protocols that support communication.
CO2: Develop and implement connection-oriented and connectionless communication using Socket API for a given set of requirements.
CO3: Develop and implement concurrent and iterative servers and analyze their functionality.
CO4: Apply advanced programming techniques such as Broadcasting and Multicasting.
CO5: Develop and implement simple network applications using NS-2 API for a given set of requirements and demonstrate its working.

CONCEPTS TO BE COVERED

1. Basic networking commands
2. TCP one-way communication
3. TCP two-way communication
4. UDP one-way communication
5. UDP two-way communication
6. Concurrent, Iterative Server Implementation
7. IP header setting by kernel and displaying IP header
8. IP header setting by user and displaying IP header
9. IP Checksum Computation
10. Ping Implementation
11. Broadcasting using UDP
12. Multicast Communication using UDP
13. Simulations / Developing networking applications

19MAM51 - ADVANCED MACHINE LEARNING

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM42

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Use ensemble techniques and dimensionality reduction methods for building machine learning models.
CO2: Understand the optimization techniques and regularization adopted in machine learning algorithms.
CO3: Learn the properties of kernels, kernel functions and apply them in pattern analysis.
CO4: Recognize the application of markov chain approaches for random sampling and model probabilities and use them in applications.
CO5: Apply the concept of graphical models in machine learning problems

ENSEMBLE LEARNING
Introduction to multiple models-Bagging: Bagged Decision Tree-Random Subspaces-Random Forest. Boosting: AdaBoost-Gradient Boosting Machines-Stochastic Gradient Boosting-XGBoost. Stacking: Voting.
Dimensionality Reduction Techniques: Principal Component Analysis- Factor Analysis-Multidimensional Scaling-Linear Discriminant Analysis- Singular Value Decomposition.

(10)

MODEL EVALUATION AND OPTIMIZATION
Classification Performance Metrics: ROC, PR Curves, Precision at K. Class Imbalance: Over and Under sampling, SMOTE. Bias-Variance Trade-offs-Cross Validation: Stratified Splits and Temporal CV. Model Tuning: Grid and Random Search Regularization: L1 and L2 Norm Methods-LASSO and Ridge Regression.

(11)

KERNEL MACHINES
Kernels-Optimal Separating Hyperplane-Kernel Trick-Vectorial Kernels-Multiclass Kernel Machines. Support Vector Classification-Support Vector Regression -Application of Support Vector Machines.

(9)

MARKOV CHAIN MONTE CARLO METHODS
Sampling-Markov Chains-The metropolis-Hastings Algorithm-Gibbs Sampling.

(7)

GRAPHICAL MODELS
Bayesian Networks-Belief Propagation-Undirected Graphs: Markov Random Fields-Hidden Markov Models: Forward algorithm.

(8)

TOTAL HOURS: 45

TEXTBOOKS

1. Stephen Marsland, Machine Learning- An Algorithmic Perspective, CRC Press, Second Ed.,2015. (Para-I)
2. Henrik Brink, Joseph Richards, Mark Fetherolf, Real World Machine Learning, Manning Publishers,2016. (Para-II)
3. Ethem Alpaydin, Introduction to Machine Learning, Fourth Ed., PHI Publication,2015. (Para III,IV,V)

REFERENCES

1. Scholkopf, B. and Smola, A. J., Learning with Kernels: Support Vector Machines, Regu- larization, Optimization, and Beyond, The MIT Press 2001.
2. Koller D. and Friedman, N., Probabilistic Graphical Models: Principles and Techniques, The MIT Press 2009.
3. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2010

19MAM52-ARTIFICIAL NEURAL NETWORKS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES

CO1: Learn the fundamentals concepts of the early Neural Network architectures and its applications.
CO2: Implement Perceptron and Backpropagation learning rules to solve problems.
CO3: Understand the different types of unsupervised learning techniques of Artificial Neural Networks.
CO4: Apply Radial Belief Network for Classification problems
CO5: Design and implement associative memories networks.

INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS

Artificial neural networks Vs Biological neural networks, ANN architecture, Basic building block of an artificial neuron, Activation functions, Early ANN architectures (basics only)-McCulloch & Pitts model, Perceptron, ADALINE, MADALINE-Feed forward neural network, feed backward neural network.

(5)

ARTIFICIAL NEURAL NETWORKS-SUPERVISED LEARNING

Perceptron and its learning law- Learning rule: Perceptron Learning Rule-Gradient Descent and the Delta learning rule- Limitations-Multi-Layer Perceptron-Backpropagation networks: Architecture, Backpropagation Learning Algorithm-Derivation-Training and Convergence-Accelerated learning in multilayer perceptron.

(9)

ARTIFICIAL NEURAL NETWORKS-UNSUPERVISED LEARNING

Hebbian Learning, Generalized Hebbian learning algorithm, Competitive learning. Self- Organizing Computational Maps: Kohonen Network- Hopfield Networks-Boltzmann Machine.

(11)

RADIAL BASIS FUNCTION (RBF) NETWORKS

Introduction-RBF regularization theory-Generalized RBF Networks-Learning in RBFs- RBF application to Face Recognition

(10)

ADAPTIVE RESONANCE THEORY

Network and learning rules. **Associative memory:** auto-associative memory, bi-directional associative memory (BAM). Regularization in ANNs-Applications of Neural Networks.

(10)

TOTAL HOURS: 45

TEXTBOOKS

1. Simon O. Haykin, Neural Networks and Learning Machines, Pearson Education, 2016.

REFERENCES

1. L. Fausett, *Fundamentals of Neural Networks*, Prentice Hall,2004
2. Artificial Neural Networks-B. Yegnanarayana, PHI, New Delhi 1998.
3. C. Bishop, Neural Networks and Machine Learning, Springer, 1998.

19MAM53 - KNOWLEDGE BASED SYSTEMS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Understand the concepts central to the creation of knowledge bases and expert systems.
CO2: Identify the components of a knowledge based systems (KBS)
CO3: Explore the issues involved in the design and development of Artificial Intelligence Based Decision Support Systems and discuss the role these systems play in the business environment.
CO4: Select an appropriate knowledge representation and reasoning method, and anticipate potential difficulties in developing and introducing the expert systems.
CO5: Examine properties of knowledge search techniques and understand the application domains of KBS.

INTRODUCTION TO KNOWLEDGE-BASED SYSTEMS (KBS)
Definition- Types of Knowledge -Comparing with Decision Support Systems-From File Server to Knowledge Server-Applications of Knowledge-based Systems-Limitations-Future of KBS- Artificial Intelligence and Expert Systems: Basics of Artificial Intelligence-Components of Expert Systems-Modes and Applications-Advantages and Limitations-Expert Systems vs Traditional Systems.

(10)

DEVELOPMENT OF KNOWLEDGE-BASED SYSTEMS
Development Strategies-Feasibility Study-Design and User Specification-Activities of Detailed Design. Knowledge Acquisition: Overview-Organization for Knowledge Acquisition-Decision Tables and Production Rules-Testing the Knowledge Base-Distribution of Repository.

(8)

DATA AND KNOWLEDGE REPRESENTATION
From Files to Knowledge Bases- -Knowledge Coding and Representation Methods- Database and Knowledge Bases-Intelligent Systems.

(7)

INFERENCES AND UNCERTAINTY
Strategies for Reasoning and Searching-Control-Conflict Resolution-Rule Based Systems-Uncertainty Rules-Approaches to Uncertainty Management-Fuzzy Logic.

(10)

RESOURCES FOR KBS
Processors-Programming for KBS: LISP and PROLOG-CLIPS framework. Selected Expert System Applications: Marketing-Software Engineering-Management of Natural Resources-Medicine-Agriculture.

(10)

TOTAL HOURS: 45

TEXTBOOKS

1. D.Partridge, Hussain,K.M. Knowledge Based Information Systems, Mc Graw Hill, 1996.
2. Jay Liebowitz, The Handbook of Applied Expert Systems, 2019 (Para V).

REFERENCES

1. Joseph Giarrantano, Gary Riley, Expert Systems: Principles and Programming, PWS Publishing Company,Paperback,2007
2. Dan.W. Patterson, Introduction to Artificial Intelligence and Expert Systems,PHI, 2007.
3. Rajendra Arvind Akerkar, Priti Srinivas Sajja, Knowledge Based Systems, Jones & Bartlette Publishers,2010.

19MAM54 - AI SYSTEMS ENGINEERING

Contact hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Understand the concept of an Intelligent System (IS) and goals of AI-Enabled Systems
CO2: Create intelligence using different approaches including machine learning
CO3: Implement production-quality systems that are robust to mistakes of AI components
CO4: Compare the intelligence and evaluate the accuracy of the AI-based systems using appropriate methods.
CO5: Build an AI based system from end to end and leverage machine learning in practice.

APPROACHING AN INTELLIGENT SYSTEMS (IS) PROJECT
Elements of Intelligent Systems-Examples-Making an Intelligent System-Problems that need Information Systems- Working with data. Goals and Success Measure for AI-Enabled Systems: Defining Goals-Types of Goals-Measuring Goals-Component of Intelligent Experience-Modes of Intelligent Interaction-Properties of good data-Understand Outcomes-Verifying Intelligent Experiences.

(12)

MODELS TO AI-ENABLED SYSTEMS
Presenting Intelligence to Users-Achieving System Objectives-Minimizing Intelligence Flaws-Create Data to Grow the System-Trade-offs among modeling techniques.

(8)

RISKS AND PLANNING FOR MISTAKES
Mistakes made by IS-Changes in Intelligence-The Human Factor-Balancing Intelligent Experience-Dealing with Mistakes.

(8)

MODEL QUALITY AND TESTING
Evaluating Accuracy-Evaluating Other Types of Predictions-Using Data for Evaluation-Comparing Intelligence-Common Challenges-Quality Assessment in Production.

(9)

SOFTWARE ARCHITECTURE FOR AI-ENABLED SYSTEMS
Considerations for Positioning Intelligence-Static Intelligence in the Product-Client side and Server-side Intelligence-Backend and Hybrid Intelligence-An Intelligent System Checklist.

(8)

TOTAL HOURS: 45

TEXTBOOK

1. Building Intelligent Systems: A Guide to Machine Learning Engineering, Geoff Hulten, APress,2018. (Chap.1,2,4,5,6,7,13,15,17,18,19,24)

REFERENCES

1. https://ckaestne.github.io/seai/F2020/
2. https://github.com/ckaestne/seai/blob/F2020/assignments/I1_case_study.md

19MAM55 - DISTRIBUTED AND CLOUD COMPUTING

Contact hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Explain the core concepts of the cloud computing paradigm
CO2: Compare the service models offered by different service providers and choose appropriate platforms for implementing cloud computing solutions considering management, security and trust requirements.
CO3: Analyze various cloud programming models and apply them to solve problems on the cloud.
CO4: Elucidate the concept, features, use cases, and benefits of containers, and the difference between containers and virtual machines.
CO5: Explain the basic concepts of microservices and container orchestration.

DISTRIBUTED SYSTEM MODELS AND ENABLING TECHNOLOGIES
Technologies for Network-Based Systems - System Models for Distributed and Cloud Computing - Software Environments for Distributed Systems and Clouds - Performance, Security, and Energy Efficiency.

(6)

CLUSTERS and VIRTUALIZATION OF CLUSTERS
Clustering for Massive Parallelism - Computer Clusters and MPP Architectures -Design Principles of Computer Cluster. Implementation Levels of Virtualization -Virtualization Structures/Tools and Mechanisms -Virtualization of CPU, Memory, and I/O Devices -Virtual Clusters and Resource Management -Virtualization for Data-Center Automation.

(9)

COMPUTING CLOUDS AND SERVICE ORIENTED ARCHITECTURE
Cloud Platform Architecture: Cloud Computing and Service Models -Data Center Design and Interconnection Networks - Architectural Design of Compute and Storage Clouds - Public Cloud Platforms: GAE, AWS, and Azure - Inter-cloud Resource Management - Cloud Security and Trust Management.
Service-Oriented Architecture for Distributed Computing: Services and Service oriented Architecture - Message- oriented Middleware - Service Registries - Basic Workflow.

(12)

CLOUD PROGRAMMING AND SOFTWARE ENVIRONMENTS
Features of Cloud and Grid Platforms - Parallel and Distributed Programming Paradigms - Programming Support of Google App Engine - Programming on Amazon AWS and Microsoft Azure - Emerging Cloud Software Environments.

(9)

MICROSERVICES AND CONTAINERS

Introduction to Microservices - Migrating and Implementing Microservices - Containerization: Docker Container - Container Orchestration - Container Management.

(9)

TOTAL HOURS: 45

TEXTBOOKS

1. Kai Hwang,Geoffrey C Fox, John J Dongarra, Distributed and Cloud Computing From Parallel Processing to the Internet of Things", Morgan Kaufmann, 2012.(Para I-IV)
2. Parminder Singh Kocher, "Microservices and Containers", Addison Wesley, 2018. (Para V)

REFERENCES

1. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2. Chris Wolf, Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", Apress Series 2005.
3. Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter, "Cloud Computing - A practical Approach", Tata McGrawHill, 2010.

19MAM56 - ADVANCED MACHINE LEARNING LAB

Contact hours

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

CO1: Implement bagging, boosting and Random Forest methods for classification and regression problems.

CO2: Apply hyper-parameter tuning and dimensionality reduction techniques to improve the performance of the models.

CO3: Use support vector machines, Hidden Markov Models and Bayesian Belief networks on real-time datasets and draw insights.

CO4: Implement various neural network models like perceptron, associative nets, Self-organizing maps (SOM) etc without using libraries for simple problems.

CO5: Design and implement Artificial Neural Networks and Radial Belief Network to classify images.

CONCEPTS TO BE COVERED

1. Ensemble learning methods in building classifiers
    - Bagging
    - Boosting and
    - Stacking algorithms
2. Download a large dataset with more dimensions and apply dimensionality reduction techniques like PCA, LDA, SVD etc on it and compare the classifier performance using various metrics.
3. Dealing with class imbalance in ML models using SMOTE methods
4. Improving model performance through hyper-parameter tuning methods
    - Cross Validation
    - GridSearchCV, Random SearchCV, Optimization algorithms etc
    - Optimizing the models using L1 and L2 regression
5. Support Vector Machine for classification and Regression
6. Bayesian Belief network implementation
7. Sequence classification using Hidden Markov Model

Artificial Neural Networks (ANN)

1. Design a perceptron for logic gates
2. Implementing back propagation algorithm
3. Implement Auto-associative Neural network and
4. SOM
5. Classification using Radial Basis Networks
6. Design and implement an ANN model to classify images. (with and without library)
7. Simple image classification applications using ANN with datasets from Kaggle and performance tuning.

19MAM57 - FULL STACK WEB DEVELOPMENT LAB

Contact hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
19MAM17

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Develop web pages that function using external data -HTML and CSS.
CO2: Use Javascript to implement client-side validations and perform AJAX calls
CO3: Apply AngularJS and /ReactJS to develop frontend dynamic web UI
CO4: Implement CRUD operations on database (MongoDB) in NODE.js
CO5: Build end-to-end web applications handling all the areas of the tech-stack and any of the web frameworks.

CONCEPTS TO BE COVERED

1. **Front-End**
    - HTML Basics
    - CSS-styling, selectors, box model, border, margin, padding
        - Develop responsive websites using HTML and CSS. (Eg.Video Player, Educational Game)
    - JavaScript
        - Fundamentals, Hoisting, Callbacks, Asynchronous JavaScript, DOM Manipulation, JSON, AJAX Calls, JQuery etc.
2. **Front-End Frameworks and Libraries**
    - Angular JS or React JS
        - Single page web application development
3. **Back-end**

- Node.Js
    - Building a HTTP Server with Node.JS using HTTP APIs
    - Buffers, Streams, and Events

4. **Work with MongoDB**
    - Create a database and set up function to interface with it in a CRUD pattern
5. **Work with APIs**
    - Build an endpoint that can send out a tweet using the Twitter API

Note: Development of complete web application end-to end may be the final exercise

19MAM58- CLOUD COMPUTING LAB

Contact hours

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

CO1: Demonstrate knowledge on creating, cloning, migrating virtual machines using VirtualBox, a virtualization tool.

CO2: For a given system configuration, can use EC2 to acquire instances.

CO3: Develop applications, launch it on Google App Engine, and access it with proper authentication mechanisms.

CO4: Construct a private cloud using the open-source cloud technologies such as OpenStack/CloudStack/OpenNebula for a given requirement.

CO5: Given an application, can create Micro services, can containerize, and deploy.

VIRTUALIZATION - VIRTUAL BOX

- Create virtual machines of different configurations
- Communication between host and virtual machine
- Communication between virtual machine to virtual machine
- Show the virtual machine migration from one node to the other.

PRIVATE CLOUD

Use Eucalyptus or OpenStack or CloudStack or equivalent to set up a private cloud and demonstrate:

- Create virtual machines of different configurations. Check how many virtual machines can be utilized at a particular time.
- Attach a virtual block to the virtual machine and check whether it holds the data even after the release of the virtual machine.
- Install a C compiler in the virtual machine and execute a sample program.
- Show the virtual machine migration from one node to the other.
- Install storage controller and interact with it.

PUBLIC CLOUD

Explore any public cloud to access various services provided by it.

CONTAINERIZATION

- Implement Docker and Kubernetes based application development and deployment
- Choose a ML Application, Containerize and deploy in Cloud.
- Adapt DevOps for basic testing (unit test) and deployment

19MAM59 - PERSONALITY DEVELOPMENT

Contact hours

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

CO1: Ascertain the various concepts of Self like the Physical Self – Energy Self – Intellectual Self –Mental Self – Blissful Self with respect to the Western (Occidental) and Eastern (Oriental) theories of Self and Personality Development.

CO2: Outline the significant effects of Self Confidence to build team confidence, given the foundation principles of Self-Motivation and Confidence.

CO3: Assess the various personalities and Attitudes and choose the best attitude for making bold decisions in personal and professional contexts.

CO4: Project the appropriate grooming and the right etiquette in the corporate context to excel in professional life.

CO5: Set Career goals and formulate strategies by Prioritizing, organizing and scheduling the required tasks. Project the appropriate grooming and the right etiquette in the corporate context to excel in professional life.

PERSONALITY DEVELOPMENT

One's Personality Sends Out a Signal That Others Read – Same Person: Consciously Different Personalities can be Powerful – There isn't One Right Personality; It Differs by Role – Learning about Personality Development from the Three Cases – Personality Analysis – Freudian Analysis of Personality Development – Swami Vivekananda's Concept of Personality – Development: Physical Self – Energy Self – Intellectual Self – Mental Self – Blissful Self – Personality Begets.

(7)

LEADERSHIP QUALITIES & INTERPERSONAL SKILLS

Resolving Conflict – A Smiling Face – Appreciative Attitude – Assertive Nature –Communication Skills – Listening Skills – Developing Empathy – The Personality Attribute of Taking Bold Decisions – Personality Types and Leadership Qualities – Mapping the Different Personality Types – Personality Tests: Example of a Personality Test: Jung Typology Test – Personality Assessment.

(7)

ETIQUETTE

Social Etiquette – Corporate Etiquette - Personal Grooming – Using minimal Body Language –Leadership and Entrepreneurship: Corporate Training – Professionalism - Self awareness –Creativity skills – Cognitive Development – Assertiveness – Positive Thinking and Attitude.

(8)

GOAL SETTING AND TIME MANAGEMENT

Goal Setting – Immediate, Short Term and Long Term Goals – Smart Goals – Strategies to
Achieve Goals - Confidence Building, Self-esteem, Motivation - Time Management –Identifying Time Wasters – Time Management Skills.

(8)

TOTAL HOURS: 30

REFERENCE BOOKS

1**.** Mitra K.Barun, “Personality Development and Soft Skills”, Oxford University Press, 2011.
2. Krishna Mohan, Meera Banerji. “Developing Communication Skills” Macmillan Publishers, 2012.
3. Sai Lakshmi. B, “Poly Skills- A Course in Communication and Life Skills” Cambridge University Press, 2012.
4. Simon Sweeney, English for Business Communication, Cambridge University Press, 2013.
5. Meenakshi Raman, Sangeeta Sharma, Technical Communication - Principles and Practice,2nd Edition, Oxford University Press, New Delhi, 2015.

19MAM61 - INTELLIGENT AGENTS

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES:
19MAM31,19MAM53

COURSE OUTCOMES
CO1: Understand agents. agent types, structure and their interactions
CO2: Appreciate the utility of different types of AI agents.
CO3: Learn and use multi agent systems and their interactions to reach agreements.
CO4: Demonstrate communication language used by the agents for their coordination and coherence.
CO5: Review the cooperative distributed problem-solving techniques used by agents with task and result sharing.

INTELLIGENT AGENTS
Introduction-Environments of Intelligent Agents-Agents and Objects-Agents and Expert Systems-Agents as Intentional Systems-Abstract Architectures for Intelligent Agents-Synthesizing Agents-Deductive Reasoning Agents.

(8)

PRACTICAL REASONING AGENTS
Practical Reasoning- Means-Ends Reasoning-The Blocks World- Implementing a Practical Reasoning Agent-Commitment to Ends and Means-The Procedural Reasoning System.
Reactive and Hybrid Agents: Brooks and the Subsumption Architecture-The Limitations of Reactive Agents, Hybrid Agents.

(10)

MULTI-AGENT INTERACTIONS
Utilities and Preferences- Multiagent Encounters- Dominant Strategies and Nash Equilibria-Competitive and Zero-Sum Interactions-The Prisoner's Dilemma.
Reaching Agreements
Mechanism Design, Auctions, Negotiation, Task-Oriented Domains, Worth-Oriented Domains, Argumentation.

(12)

COMMUNICATION AND CO-OPERATION
Speech Acts - Agent Communication Languages-KIF-KQML-The FIPA Agent Communication Languages-Ontologies for Agent Communication-Coordination Languages.
Cooperative Distributed Problem Solving-Coherence and Coordination-Task Sharing and Result Sharing-Task Sharing in the Contract Net-Result Sharing-Handling Inconsistency- Coordination-Multiagent Planning and Synchronization.

(10)

CASE STUDY
Applications of Agents in Various Domains-Building multi-agent systems.

(5)

TOTAL HOURS: 45

TEXTBOOKS

1. Michael Wooldridge, “An Introduction to Multi Agent Systems”, 2nd Edition, John Wiley & Sons, 2009.
2. G. Weiss. “Multiagent Systems--A Modern Approach to Distributed Artificial Intelligence”, 2nd Edition, MIT Press, Cambridge,2013. (Last Para)

REFERENCES

1. Praveen Palanisamy, “Hands-On Intelligent Agents with OpenAI Gym: Your Guide to Developing AI Agents Using Deep Reinforcement Learning”, Packt, 2018.
2. Fabio Luigi Bellifemine, Giovanni Caire, Dominic Greenwood, “Developing Multi-Agent Systems with JADE” , John Wiley & Sons, 2007.
3. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Pearson Education, 2015.

19MAM62 - DEEP LEARNING

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
19MAM52

COURSE OUTCOMES
CO1: Understand the concepts of feedforward and deep networks and regularization principles.
CO2: Implement and visualize Convolutional Neural Networks algorithms for classification problems.
CO3: Identify Recurrent Neural Network algorithms which are more appropriate for various types of learning tasks in various domains.
CO4: Review the unsupervised deep learning models- deep generative models and autoencoders for predictive learning.
CO5: Apply the optimization techniques and fine tune the deep neural networks while designing deep learning algorithms for varied applications.
CO6: Learn the basics of transfer learning and its application in deep learning

DEEP FEEDFORWARD NETWORKS
Feed Forward Networks-Learning XOR-Gradient Based Learning Hidden Units-Architectural Design-Empirical Risk Minimization-Backpropagation.

(8)

REGULARIZATION FOR DEEP LEARNING
Parameter Norm Penalties - Norm Penalties as Constrained Optimization - Regularization and Under - Constrained Problems - Dataset Augmentation - Noise Robustness - Semi-Supervised Learning - Multi-Task Learning - Early Stopping - Parameter Tying and Parameter Sharing - Sparse Representations - Bagging and Other Ensemble Methods – Dropout.

(7)

OPTIMIZATION FOR TRAINING DEEP MODELS
Learning vs Pure Optimization-Challenges in Neural Network Optimization-Basic Algorithms- Parameter Initialization Strategies-Algorithms with Adaptive Learning Rates-Approximate Second-Order Methods-Optimization Strategies and Meta-Algorithms.

(7)

CONVOLUTIONAL NEURAL NETWORKS(CNN)
Basic Structure of a Convolution Network-Training a CNN-Case Studies of CNN Architecture-Visualization and Unsupervised Learning -Applications of CNNs. **Autoencoders:** Architecture-Applications.

(8)

RECURRENT NEURAL NETWORKS (RNN)
Architecture of RNN-Challenges in Training NN- Echo state Networks-Long Short-Term Memory-Applications of RNN. Transformers in Deep Learning: Architecture-Comparison to RNN and CNN-Applications.

(7)

TRANSFER LEARNING

Fundamentals of Transfer Learning: Definition-Transfer Learning Types-Methodologies-Need and Challenges. Fundamentals of Pre-Trained Models-Examples-Image Classification using Pre-trained Models.

(8)

TOTAL HOURS: 45

TEXTBOOKS

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017. (Para I-III).
2. Charu C Aggarwal, "Neural Networks and Deep Learning", Springer, 2018. (Para IV,V)
3. Dipanjan Sarkar, Raghav Bali, "Transfer Learning in Action", Manning. 2021.(Para VI)

REFERENCES

1. Nikhil Buduma, "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", O'Reilly publications,2017
2. Dipanjan Sarkar, Raghav Bali, T. Ghosh, "Hands-on Transfer Learning with Python", Packt,2018.
3. https://theaisummer.com/transformer/

19MAM63 - INFORMATION RETRIEVAL AND WEB SEARCH

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
Consent of the Instructor

COURSE OUTCOMES
CO1: Understand the basic concepts and techniques in information retrieval
CO2: Apply the information retrieval models.
CO3: Evaluate an information retrieval system based on the relevance of the documents it retrieves.
CO4: Analyze the documents and query performances of system
CO5: Explore the techniques in text and multimedia retrieval process

INFORMATION RETRIEVAL AND SEARCH PROCESS
Introduction to Information Retrieval(IR) – The IR Problem –The IR system – The web – User Interface for Search – Search by Users – Search Interfaces Today – Visualization in Search Interfaces – Design and Evaluation of Search Interfaces.

(7)

MODELING AND RETRIEVAL EVALUATION
IR Models – Classic Information retrieval-Boolean Model- Term weighting – TF-IDF Weight – Document Length Normalization – Vector Model – The Hypertext Model – Web based Models – Structured Text Retrieval – Multimedia Retrieval – Enterprise and Vertical Search - Retrieval Evaluation: The Cranfield paradigm – Retrieval Metrics – User Based Evaluation.

(10)

RELEVANCE FEEDBACK AND QUERY EXPANSION
Framework for Feedback Methods – Explicit Relevance Feedback – Explicit Feedback Through Clicks – Implicit Feedback Through Local Analysis.

(8)

DOCUMENTS AND QUERIES-LANGUAGES
Meta data – Document formats – Mark-up Languages and Properties– Document Pre-processing – Queries: Languages and Properties – Query Languages – Query Properties –Indexing and Searching- Inverted Indexes.

(8)

WEB RETRIEVAL AND CRAWLING
Search Engine Architecture – Search Engine Ranking- Managing Web Data –Search Engine User Interaction –Web Crawling: Applications of Web Crawler-Taxonomy of Crawlers – Crawler Architecture

(7)

TEXT AND MULTIMEDIA RETRIEVAL
Structuring Power – XML Retrieval – Multimedia Information Retrieval – Challenges – Content Based Image Retrieval

(5)

TOTAL HOURS: 45

TEXTBOOK

1. Ricardo Baeza-Yate, Berthier Ribeiro-Neto, "Modern Information Retrieval", Second Edition, ACM Press Books, 2011.

REFERENCES

1. C. Manning, P. Raghavan, and H. Schütze, “Introduction to Information Retrieval”, Cambridge University Press, 2009.
2. Stefan Büttcher, Charles L. A. Clarke, Gordon V. Cormac, “Implementing and Evaluating Search Engines”, MIT Press, 2016.

19MAM64 - BIG DATA ANALYTICS

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
19MAM42

COURSE OUTCOMES
CO1: Learn the concepts of big data characteristics and its applications
CO2: Apply map-reduce programming to parallelize data centric problems using Hadoop and HDFS
CO3: Exposure to data analytics using various Hadoop ecosystem tools.
CO4: Understand stream processing and perform stream analytics on real-time problems.
CO5: Implement real-time streaming analytics using Spark Streaming API.

INTRODUCTION TO BIG DATA
Big Data Characteristics - Scalability and Parallel Processing - Designing Data Architecture - Data Sources and Quality - Data Storage and Analysis - Big Data Analytics Applications and Case Studies. Data Analytics Lifecycle - Six Phases: Discovery-Data Preparation-Model Planning-Model Building-Communicate Results-Operationalize.

(6)

HADOOP AND MAP REDUCE
Hadoop and its Ecosystem– Installing Hadoop-Understanding Hadoop Features-Learning HDFS and MapReduce Architecture-Understanding Hadoop MapReduce Fundamentals-Writing a Hadoop MapReduce-Examples.

(9)

BIG DATA TECHNOLOGIES
NoSQL- Big Data Management using NoSQL, MangoDB and Cassandra, Hadoop Ecosystem Tools - Hive, HiveQL, Pig, Spark and Big Data Analytics – Apache Mahout Machine Learning Applications.

(10)

DATA STREAM MINING
Data Stream Concepts and Data Stream Management: Data stream concepts - Data Stream Model - Architecture - Data Stream Management System (DSMS) - Examples of sources of streams - Stream Queries - Stream Processing Issues - Real-time Processing, Stream Processing and Batch Processing - Stream Computing Aspects - Frequent Itemsets Mining in a Stream.

(10)

REAL-TIME ANALYTICS
Apache Spark Streaming-Real-time Analytics Platform (RTAP) Applications-Case Studies: Real-Time Sentiment Analysis, Positive Negative Sentiments Prediction and Stock Market Prediction.

(10)

TOTAL HOURS: 45

TEXTBOOKS

1. Raj Kamal and Preeti Saxena, "Big Data Analytics: Introduction to Hadoop, Spark, and Machine-Learning", McGraw-Hill Education, 2019. (Para I, III-V)
2. Vignesh Prajapathi, "Big Data Analytics with R and Hadoop", Packt Publishing, 2013. (Para II)
3. Data Science and Big Data Analytics, EMC Educational Services, Wiley, 2015. (Para I)

REFERENCES

1. Kai Hwang and Min Chen, "Big-Data Analytics: for Cloud, IoT and Cognitive Computing", Wiley Edition, 2018.

2. Bill Chambers and Matei Zaharia, “Spark: The Definitive Guide”, O’Reilly, 2018.

19MAM65 - DEEP LEARNING LAB

Contact Hours

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

PRE-REQUISITES
Consent of the Instructor

COURSE OUTCOMES
CO1: Design single and multi-layer feed-forward deep networks and tune various hyper-parameters.
CO2: Build classification models using convolutional neural networks, recurrent neural networks for real-time applications.
CO3: Implement hyperparameter tuning and optimization techniques to improve the performance of the Deep neural networks.
CO4: Use of LSTM network in real-time prediction problems.
CO5: Apply pretrained models in practice with large image datasets and perform classification efficiently.

CONCEPTS TO BE COVERED

- Image pre-processing for NN
- Data augmentation
- Convolutional NN
    - Simple CNN with parameters settings.
    - Classify images (faces, melanomas, etc.) based on patterns and objects that appear in them.
- Pre-trained models/Transfer learning (VGG-16, Resnet etc)
- Recurrent NN
    - Text Translation
    - Sentiment Analysis
- Predict the next word using a sample text
- Hyper parameter tuning and optimization of the model
    - Demonstrate the use of different optimization techniques and hyper-parameter tuning techniques
- Applications of Long Short-Term Memory Networks

Datasets: Benchmark datasets for image and text processing may be used. (Imagenet, CIFAR-10 etc)

REFERENCES

1. Francois Chollet, “Deep Learning with Python”, Kindle Edition,2021.
2. Dipanjan Sarkar, Raghav Bali, T. Ghosh, “Hands-on Transfer Learning with Python”, Packt,2018.

19MAM66 - MOBILE APPLICATION DEVELOPMENT LAB

Contact Hours

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

CO1: Understand the components and structure of mobile application development frameworks for Android and windows OS-based mobiles.
CO2: Work with various mobile application development frameworks and develop mobile apps.
CO3: Apply the basic UI and important design concepts and issues of development in mobile applications.
CO4: Develop mobile apps for Android OS using GPS, Storage and RSS feed.
CO5: Design mobile applications based on the capabilities and limitations of mobile devices.

CONCEPTS TO BE COVERED

1. Develop an application that uses GUI components, Font and Colors
2. Develop an application that uses Layout Managers and event listeners.
3. Write an application that draws basic graphical primitives on the screen.
4. Develop an application that makes use of databases or back-end storage for mobile apps.
5. Develop an application that makes use of notification manager
6. Implement an application that uses multi-threading
7. Develop a native application that uses GPS location information
8. Implement an application that writes data to the SD card.
9. Implement an application that creates an alert upon receiving a message
10. Write a mobile application that makes use of RSS feed
11. Develop a mobile application to send an email.

Suggested Softwares: Android SDK/Kotlin

19MAM67 - BIG DATA ANALYTICS LAB

Contact Hours

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

PRE-REQUISITES
19MAM46

COURSE OUTCOMES
CO1: Write MapReduce programs to work on Hadoop clusters.
CO2: Work with NoSQL -MongoDB for learning basic CRUD operations.
CO3: Learn and apply basic Hadoop commands and read/write data to HDFS
CO4: Implement supervised and unsupervised machine learning algorithms using SparkML library.
CO5: Perform stream analytics using real time Spark framework.

CONCEPTS TO BE COVERED

1. MapReduce Programming exercises
2. NoSQL operations (MongoDB and Cassandra)
3. Preparing data with Hadoop
4. Basic HDFS commands, Direct file transfer to HDFS
5. Importing data (CSV,Jason) into Hive Tables, using Spark
6. Data import and export with Sqoop
7. Work with Data Streams using Flume (Eg.Web Log Creation)
8. Creating Visualizations using comparison charts, composition, distribution and relationship charts.
9. Data Modelling with SparkML
    a. Applications of machine learning algorithms-Supervised and Unsupervised
    b. Evaluate Model (Cross-Validation, Model Tuning) and Prediction
10. Real-Time Analytics using SparkStreaming
11. Real-Time Sentiment Analysis
12. Collaborative Filtering

REFERENCES

1. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.

19MAM68 - COMMUNICATION SKILLS

Contact Hours

L	T	P	C
0	0	2	1

ASSESSMENT: PRACTICAL

PRE-REQUISITES:
Consent of the Instructor

COURSE OUTCOMES

CO1: Conceive appropriate verbal responses from the learners to a given social situation, using the guidelines to effective speaking skills and body language.

CO2: Generate troubleshooting solutions to develop team building and interpersonal skills with case studies that focus on body language and empathy.

CO3: Develop appropriate responses for business phone calls and formulate effective resolutions to professional conflicts that arise out of cross-cultural communication gaps in a given managerial context.

CO4: Compose appropriate written responses to professional problems faced by a team at the workplace arising out of ineffective communication skills.

CO5: Generate valid points for and against a HR topic and present them with appropriate group behavior. For any job requirement, plan and prepare for a 20-minute mock interview.

INTRODUCTION

Introduction – Code and Content – Stimulus and Response: Source – The Encoding Process – The Channel – The Decoding Process – The Receiver – Speaking Skills – Effective Speaking Guidelines – Communicating Soft Skills: A Self-assessment – Closing Tips

(4)

SOFT SKILLS

Introduction to Soft Skills – Lessons from the Three Case Studies – Change in Today's Workplace: Soft Skills as a Competitive Weapon – Antiquity of Soft Skills – Classification of Soft Skills: Time Management - Attitude – Responsibility – Ethics, Integrity, Values and Trust – Self-confidence and Courage – Consistency and Predictability – Teamwork and Interpersonal Skills - Communication and Networking – Empathy and Listening Skills – Problem Solving, Troubleshooting and Speed reading – Leadership – Body Language

(8)

TELEPHONING SKILLS & NEGOTIATIONS

Preparing to make a telephone call – Receiving calls – Taking and leaving messages – Asking for and giving repetition – The secretarial barrier – Cross-cultural communication on the telephone – Setting up appointments – Changing arrangements – Ending a call – Cross-cultural communication on the telephone – Problem-solving on the telephone – Complaints – Negotiations: Types of negotiation – Preparation for a negotiation – Making an opening statement – Bargaining and making concessions – Accepting and confirming – Summarizing and looking ahead – Types of negotiator – Dealing with conflict - Rejecting – Ending the negotiation

(8)

WRITING SKILLS TO CREATE AN IMPRESSION

Fifteen Principle to Increase Clarity in Communication – Edit-Edit-Edit: The Reader's Perspective – Clarity of Thought – Clarity of Text.

(3)

SPEAKING

Job Interviews: Types of Interviews - Groundwork before the Interview -Importance of body Language in Interview - Need for proper Articulation - Concluding an Interview - Telephonic or Video Interview - A Mock Interview - Group Discussion: Introduction - Ability to Work as a Team – Communication Skills - Active Listening - Non-verbal Communication - Leadership and Assertiveness - Reasoning – Ability to Influence - Innovation. Creativity, and Lateral Thinking - Flexibility - Key Steps to Succeed in a Group Discussion - The Responsibility of the First Speaker - Concluding the Discussion - Dos and Don'ts during a Group Discussion

(7)

TOTAL HOURS:30

19MAM69 - HACKATHON

Contact Hours

L	T	P	C
0	0	2	1

ASSESSMENT: PRACTICAL

PRE-REQUISITES:
Consent of the Instructor

COURSE OUTCOMES

CO1: To familiarize students about the various programming challenges in Hackathons and encourage the students to participate in it.
CO2: To gain experience in devising solutions to real-time problems and challenges of industry in the domain of AI/ML.
CO3: To explore research problems in the area of AI/ML and implement it.

Idea Submission and Evaluation Process

- Students are unveiled of problems on various hackathon portals, Kaggle competitions and similar challenges as given below.

Sl.No	Name of Hackathon
1.	Codevita / Hackerearth/AnalyticsVidhya
2.	Tata Cruicible Campus Hackathon
3.	Leetcode
4.	Smart India Hackathon
5	Kaggle Competitions

- The evaluation is done as continuous assessment based on the participation, problem and the solution implementation.

TOTAL HOURS: 30

19MAM81 - GRAPH REPRESENTATION LEARNING

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES:
19MAM21,19MAM42, 19MAM61

COURSE OUTCOME
CO1 : Understand the fundamental concepts of graph theory.
CO2 : Familiarize with the different graph reconstruction methods.
CO3 : Model Graph Neural Networks to solve real-time problems
CO4 : Apply Graph Generative Models for finding solutions for complex data problems
CO5 : Learn about knowledge graph and its representation

GRAPH THEORY AND CONCEPTS
Graphs -Graph Structures-Types of Graphs- -Machine learning on Graphs – Background and Traditional Approaches: Graph Statistics and Kernel Methods - Neighborhood Overlap Detection - Graph `

(8)

NODE EMBEDDINGS
Neighborhood Reconstruction Methods - Encoder-Decoder Perspective - Factorization-based approaches - Random Walk Embeddings -Limitations of Shallow Embeddings - Multi-relational Data and Knowledge Graphs

(9)

GRAPH NEURAL NETWORKS(GNNS)
The Graph Neural Network Model - Neural Message Passing - Generalized Neighborhood Aggregation - Generalized Update Methods - Edge Features and Multi-relational GNNs - Graph Pooling. Graph Neural Network in Practice: Applications and Loss Functions - Efficiency Concerns and Node Sampling - Parameter Sharing and Regularization.

(10)

GENERATIVE GRAPH MODELS
GNNs and Graph Convolutions – Graph Classification using GCNNs-GNNs and Probabilistic Graphical Models - GNNs and Graph Isomorphism. Generative Graph Models: Traditional Graph Generation Approaches - Deep Generative Models

(9)

KNOWLEDGE GRAPH
Emergence of the Knowledge Graph -Data and Graphs: Introduction-Representing Data and Knowledge in Graphs. Architecture: Creation of Knowledge Graphs - Reasoning in Knowledge Graphs.

(9)
TOTAL HOURS: 45

TEXTBOOKS

1. William L. Hamilton, ‘Graph Representation Learning’, Morgan & Claypool publishers, 2020. (Para I-IV)
2. Sean Martin, Ben Szekely, and Dean Allemang, ‘The Rise of the Knowledge Graph: Toward Modern Data Integration and the Data Fabric Architecture’, O’Reilly Media, Inc. I Edition, 2021. (Para V)

REFERENCES

1. Aldo Marzullo, Claudio Stamile, and Enrico Deusebio, Graph Machine Learning, Packt Publishing, 2021.
2. Mark Needham, Amy E. Hodler, Graph Algorithms: Practical Examples in Apache Spark and Neo4j, O’Reilly, 2019.
3. Mayank Kejriwal, Craig A. Knoblock and Pedro Szekely, ‘Knowledge Graphs: Fundamentals, Techniques, and Applications, MIT Press, 2021.

19MAM82 - REINFORCEMENT LEARNING

Contact Hours

L	T	P	C
3	0	2	4

ASSESSMENT:THEORY

PRE-REQUISITES
19MAM18,19MAM22

COURSE OUTCOMES
CO1: Familiarize with the fundamentals of Reinforcement Learning.
CO2: Understand and apply basic RL algorithms for simple sequential decision-making problems in uncertain conditions.
CO3: Examine the various model-based and model-free methods for model planning and learning.
CO4: Review the application of approximation-based algorithms for Reinforcement Learning
CO5: Learn the applications and latest trends in Reinforcement Learning
CO6: Implement reinforcement learning algorithms to solve a cognitive task

REINFORCEMENT LEARNING PROBLEM
Reinforcement Learning-Examples-Elements of Reinforcement Learning-Limitations and Scope-An Extended Example: Tic-Tac-Toe-History of Reinforcement Learning

(10)

TABULAR SOLUTION METHODS
Bandit Problems and Online Learning-Markov Decision Processes and Value Functions-Dynamic Programming-Monte Carlo Methods-Temporal Difference Learning.

(12)

PLANNING AND LEARNING
Models and Planning with Tabular Methods-Eligibility Traces

(8)

APPROXIMATE SOLUTION METHODS
Function Value Approximation-On Policy Approximation of Action Values-Off Policy Approximation of Action Values.

(10)

CASE STUDIES: Examples of Reinforcement Learning System-Applications in different domains-Alpha Go-IBM Watson-Frontiers in Reinforcement Learning-Introduction to Deep Reinforcement Learning.

(5)

PRATICALS
Implement the reinforcement learning algorithms using OpenAI Gym and Tensor flow or any RL platform.

(15)

TOTAL HOURS: 60

TEXTBOOKS

1. Richard Sutton & Andrew G. Barto, 'Reinforcement Learning: An Introduction', 1st Edition, MIT Press,2015.
2. Sudharshan Ravichandran, Sean Saito, Rajalingappa Shanmugamani and Yang Wenzhao, "Python Reinforcement Learning", Packt, 2019. (Practicals)

REFERENCES

1. Csaba Szepersvani, ‘Algorithms for Reinforcement Learning’, Morgan and Claypool Publishers, 2010.
2. Maxim Lapan, “Deep Reinforcement Learning”, Packt2, 2018.
3. Parag Kulkarni, “Reinforcement and System Machine Learning for Decision Making”, Wiley, 2012.

19MAM83 - META-HEURISTIC OPTIMIZATION TECHNIQUES

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1 : Understand the basic concepts of heuristic optimization .
CO2 : Familiarize with genetic and evolutionary algorithm and its applications in real world problem solving.
CO3 : Apply Ant colony optimization algorithmic models for various optimization problems.
CO4 : Implement particle swam optimization algorithm and Firefly algorithms for problem solving.
CO5 : Solve computational problems using Honeybee optimization techniques.

OVERVIEW OF OPTIMIZATION
Optimization - Objective Function - Decision Variables - Solutions of an Optimization Problem - Decision Space - Constraints or Restrictions - State Variables - Local and Global Optima - Near-Optimal Solutions

(6)

INTRODUCTION TO META-HEURISTIC AND EVOLUTIONARY ALGORITHMS
Searching the Decision Space for Optimal Solutions - Definition of Terms of Meta-Heuristic and Evolutionary Algorithms Principles of Meta-Heuristic and Evolutionary Algorithms - Classification of Meta-Heuristic and Evolutionary Algorithms - Meta-Heuristic and Evolutionary Algorithms in Discrete or Continuous Domains - Generating Random Values of the Decision Variables - Dealing with Constraints -Selection of Solutions in Each Iteration - General Algorithm - Performance Evaluation of Meta-Heuristic and Evolutionary Algorithms.

(8)

GENETIC ALGORITHMS
Introduction - Mapping the Genetic Algorithm (GA) to Natural Evolution - Creating an Initial Population - Selection of Parents to Create a New Generation - Population Diversity and Selective Pressure - Reproduction - Termination Criteria - User-Defined Parameters of the GA.

(8)

THE ANT COLONY OPTIMIZATION METAHEURISTIC
Combinatorial Optimization - The ACO Metaheuristic - How Do I Apply ACO? - Other Metaheuristics - **Ant Colony Optimization Algorithms for the Traveling Salesman Problem :** The Traveling Salesman Problem - ACO Algorithms for the TSP - Ant System and Its Direct Successors - **Particle Swarm Optimization :** Introduction - Mapping Particle Swarm Optimization (PSO) to the Social Behavior of Some Animals - Creating an Initial Population of Particles - The Individual and Global Best Positions - Velocities of Particles - Updating the Positions of Particles - Termination Criteria - User-Defined Parameters of the PSO.

(10)

HONEY-BEE MATING OPTIMIZATION

Introduction - Mapping Honey-Bee Mating Optimization (HBMO) to the Honey-Bee Colony Structure - Creating an Initial Population - The Queen - Drone Selection - Brood (New Solution) Production - Improving Broods (New Solutions) by Workers - Termination Criteria - User-Defined Parameters of the HBMO.

(7)

FIREFLY ALGORITHM

Introduction - Mapping the Firefly Algorithm (FA) to the Flashing Characteristics of Fireflies - Creating an Initial Population – Attractiveness - Distance and Movement - Termination Criteria 200 16.7 User-Defined Parameters of the FA

(6)

TOTAL HOURS : 45

TEXTBOOKS

1. Omid Bozorg-Haddad, Iran Mohammad Solgi, Iran Hugo A. Loaiciga, "Meta-Heuristic and Evolutionary Algorithms for Engineering Optimization", John Wiley & Sons, 2017.
2. Marco Dorrigo, Thomas Stutzle, "Ant Colony Optimization", PHI,2005 (Para IV)

REFERENCES

1. Leandro Nunes de Castro, "Fundamentals of Natural Computing: Basic concepts, Algorithms and Applications ", CRC Press,2007.

2. Carlos A. Coello Coello Gary B. Lamont David A. Van Veldhuizen, "Evolutionary Algorithms for Solving Multi-Objective Problems", Second Edition, Springer, 2007.

3. Kwang Y. Lee and Mohamed A. El-Sharkawi, "Modern Heuristic Optimization Techniques Theory and Applications to Power Systems", Wiley, 2008.

19MAM84 - META-HEURISTIC OPTIMIZATION LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Implement optimization techniques on specific applications
CO2: Understand and perform Binary and Continuous Genetic Algorithm in real time application
CO3: Apply evolutionary computation methods to solve complex problems
CO4: Learn and use various Extreme Learning Machine techniques for real time application
CO5: Summarize current research in Genetic Algorithms and Evolutionary Computing

TOPICS TO BE COVERED

1. Implement ANT Colony Optimization.
2. Implement Particle Swarm Optimization (PSO).
3. Multi objective optimization in Genetic Algorithm.
4. Adaptive mutation in Genetic Algorithm.
5. Binary Genetic Algorithm
6. Continuous Genetic Algorithm
7. Build Extreme Learning Machine (ELM).
8. ELM for Multi-Class Classification.
9. Genetic Algorithm Based Approach in attribute weighting for a Medical Data Set.
10. Elementary Operations on L-R Fuzzy number.

Suggested Software: Python/Matlab

REFERENCES

1. Fister Jr., X.-S. Yang, I. Fister, J. Brest, "Memetic firefly algorithm for combinatorial optimization in Bioinspired Optimization Methods and their Applications", Slovenia, 2012.
2. Marco Dorigo and Thomas Stützl, "Ant Colony Optimization", The MIT Press, 2004.

19MAM91 - COMPUTER VISION

Contact hours

L	T	P	C
3	0	0	3

PRE-REQUISITES:
19MAM42

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1: Understand and use the vision technology in conjunction with real world applications.
CO2: Detecting features, discuss feature correspondences across different images and review image segmentation techniques like Active contours, Split and merge, Mean shift and mode finding.
CO3: Investigate techniques like shading and focus, merging multiple range or depth images into 3D models, and reconstructing them.
CO4: Perform pose estimation, camera's intrinsic calibration, estimate 3D point structure from 2D matches, 3D geometry, camera motion and the motion between two or more images.
CO5: Reconstruct the 3D shape of a scene from images taken from different views.

IMAGE FORMATION AND FILTERING

Introduction to computer vision - Photometric image formation - The digital camera - Point operators - Linear filtering, neighborhood operators - Fourier transforms - Pyramids and wavelets.

(9)

FEATURE DETECTION AND SEGMENTATION

Feature Detection: Points and patches – Edges - Lines.
Segmentation: Active contours - Split and merge - Mean shift and mode finding

(8)

3D RECONSTRUCTION

Shape from X - Active range finding - Surface representations - Point-based representations - Volumetric representations - Model-based reconstruction - Recovering texture maps and albedos.

(8)

MOTION ESTIMATION

Feature-based alignment: 2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration. Structure from motion: Triangulation - frame structure from motion – Factorization - Bundle adjustment - Constrained structure and motion. Dense motion estimation: Translational alignment - Parametric motion - Spline-based motion – Optical flow, Layered motion.

(12)

RECOGNITION

Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding.

(8)

TOTAL HOURS: 45

TEXTBOOK

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer-Verlag London Limited, 2011.

REFERENCES

1. Forsyth, D. and Ponce, J, "Computer Vision: a modern approach", Prentice Hall, 2002.
2. Vaibhav Verdhan, “Computer Vision Using Deep Learning: Neural Network Architectures with Python and Keras”, APress, 2021.
3. V Kishore Ayyadevara, Yeshwanth Reddy, “Modern Computer Vision with PyTorch”, 2020.

19MAM92 - CYBER THREAT INTELLIGENCE

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM42

COURSE OUTCOMES
CO1: Familiarize with the concepts of cyber threat intelligence and its requirements.
CO2: Identify methods to collect cyber threat intelligence Requirements
CO3: Analyze and Disseminate Cyber Threat Intelligence
CO4: Understand the role of cyber threat intelligence partner
CO5: Apply machine learning techniques to detect cyber security threats in web, network, emails etc.

FUNDAMENTALS OF CYBER THREAT INTELLIGENCE (CTI)
The Need for Cyber Threat Intelligence: The menace of targeted attacks - Monitor and respond strategy - Cyber Threat Intelligence Defined, Key Characteristics: Adversary based, Risk focused - Process oriented - Tailored for diverse consumers -Benefits of Cyber Threat Intelligence.
Developing Cyber Threat Intelligence Requirements: Assets that must be Prioritized: Personal information - Intellectual property - Confidential business information - Credentials and IT systems information - Operational systems. Adversaries: Cybercriminals - Competitors and cyber espionage agents - Hacktivists. Intelligence Consumers: Tactical users - Operational users - Strategic users.

(9)

CYBER THREAT INFORMATION COLLECTION
Level One Threat Indicators - File hashes and reputation data - Technical sources: honeypots and scanners - Industry sources: malware and reputation feeds. Level Two Threat: Data Feeds - Cyber threat statistics - reports and surveys - Malware analysis. Level Three: Strategic Cyber Threat Intelligence - Monitoring the underground - Motivation and intentions - Tactics, techniques, and procedures - Analyzing and Disseminating Cyber Threat Intelligence: Information versus Intelligence - Validation and Prioritization: Risk scores - Tags for context - Human assessment. Interpretation and Analysis: Reports, Analyst skills, Intelligence platform - Customization. Dissemination: Automated feeds and APIs - Searchable knowledge base - Tailored reports.

(9)

ANALYZING AND DISSEMINATING CTI
Information versus Intelligence, Validation and Prioritization: Risk scores - Tags for context - Human Assessment. Interpretation and Analysis: Reports - Analyst Skills - Intelligence Platform - Customization. Dissemination: Automated Feeds and APIs - Searchable Knowledge Base - Tailored Reports.

(7)

CYBER THREAT INTELLIGENCE PARTNER
Types of Partners: Providers of Threat Indicators - Providers of Threat Data Feeds - Providers of Comprehensive Cyber Threat Intelligence. Important Selection Criteria: Global and Cultural Reach- Historical Data and Knowledge - Range of Intelligence Deliverables - APIs and Integrations - Intelligence Platform - Knowledge Base and Portal - Client Services - Access to Experts. Intelligence - Driven Security.

(8)

DETECTING CYBER SECURITY THREATS WITH AI

Email Cyber Security Threats with AI: Detecting Spam with Perceptron, Support Vector Machines and Naïve Bayes-Spam Detection with Logistic Regression and Decision Trees- Bayesian Spam Detector.

Malware Threat Detection: AI for Malware Analysis-Decision Tree Malware Detectors-Detecting Metamorphic Malware with Hidden Markov Models-Malware and Deep Learning.

Network Anamoly Detection Techniques: Network Attacks-BotNet Topology-Machine Learning for Botnet Detection.

(12)

TOTAL HOURS: 45

TEXTBOOKS

1. Jon Friedman. Mark Bouchard, CISSP. Foreword by John P. Watters, Cyber Threat Intelligence, Definitive Guide TM, 2015. (Para I to IV).
2. Alessandro Parisi, “Hands-on Artificial Intelligence for Cyber Security”, Packt, 2019. (Para V)

REFERENCES

1. Christ Pace, Andrei Barysevich, Levi Gundert, Allan Liska, Maggie McDaniel, John Wetzel, “The Threat Intelligence Handbook : A Practical Guide for Security Teams to unlocking the power of Intelligence”, CyberEdge Group, 1997. (Para 4 : Chapters 2 and 4, Para 5 : Chapters 6,7, and 10)
2. Henry Dalziel, How to Define and Build an Effective Cyber Threat Intelligence Ca pability Elsevier Science & Technology, 2014.
3. John Robertson , Ahmad Diab , Ericsson Marin , Eric Nunes , Vivin Paliath , Jana Shakarian , Paulo Shakarian, DarkWeb Cyber Threat Intelligence Mining Cambridge University Press, 2017.

19MAM93 - COMPUTER VISION LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
19MAM65

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Explore the process of image construction and blending
CO2: Apply Image formation techniques and feature based process
CO3: Extract features from Images and do analysis of Images
CO4: Perform object detection and face recognition using CNNs and RCNNs.
CO5: Implement image classification using benchmark image datasets like CIFAR-10 and other types of images.

CONCEPTS TO BE COVERED

1. Create a set of rectangles and then modify their "pose" (2D transform)
2. Image blending, Feature-based morphing, Edge editing and enhancement
3. Interest point detector Implement one or more keypoint detectors and compare their performance
4. Implement 2D and 3D multi-object detection and segmentation
5. Combine CV with NLP to perform OCR, image captioning
6. Perform Object Detection with YOLOv3, Object Detection with Mask R-CNN,
7. Develop a New Object Detection Model
8. Feature-based image alignment for flip-book animations (Eg.Take a set of photos of an action scene or portrait (preferably in motor-drive—continuous shooting—mode) and align them to make a composite or flip-book animation.)
9. Deep Learning for Face Recognition: Detect Faces in Photographs, Face Identification and Verification with VGGFace2
10. Face Classification with FaceNet
11. Classify Black and White Photos of Clothing
12. Classify Small Photos of Objects, Label Satellite Photographs of the Amazon Rainforest

Suggested Software/Tools: PyTorch**,** OpenCV library, YOLO

REFERENCE

1. Jan Erik Solem, "Programming Computer Vision with Python", O'Reilly, 2012.
2. Jason Brownee, "Deep Learning for Computer Vision", Ebook, 2019.

19MAM94 - INTELLIGENT CYBER SECURITY LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
19MAM46,19MAM65

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Apply classification techniques for detection
CO2: Perform Preprocessing technique in face detection
CO3: Perform clustering technique for cyber security
CO4: Implement various techniques and security algorithms on specific problems.
CO5: Develop intelligent solutions/tools to detect and protect against cyber threat through data analytics for an enterprise.

CONCEPTS TO BE COVERED

- Email Spam filtering using machine learning techniques, Bayesian spam detector
- Phishing detection using ML.
- Protection against credential stuffing campaigns, a common threat tactic in the ecommerce and online services sector.
- Malware Detection using ML, PDF malware detection
- Windows Ransomware detection, Crypto Ransomware detection
- Communication Network Analysis to identify Anomalies, ML for Botnet detection
- Behavior Analytics
- Collect information from multiple sources(dark web, social media, cyber security research feeds etc) to create a reliable repository of threat-related knowledge and derive insights.
- Dynamic Intelligence feed
- Bio-metric authentication with facial recognition

Suggested Software/Tools: Python, OpenCTI

REFERENCES

1. Ali Dehghantanha, Mauro Conti, Tooska Dargahi, Cyber Threat Intelligence, Springer, 2018
2. Alessandro Parisi, “Hands-on Artificial Intelligence for Cyber Security”, Packt, 2019. (Para V)

ELECTIVE

19MAME01 - ETHICS IN AI

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES

CO1: Understand the concept of building ethics in machines
CO2: Develop and designs test cases for hypothetical cases in Self driving cars
CO3: Able to build the methodologies for ethical AI
CO4: Identify Ethical priorities in AI systems
CO5: Design AI with rights, consciousness, and freedom

ETHICAL LEARNING, NATURAL AND ARTIFICIAL

Introduction - A Social Perspective -A Developmental Perspective - Default Trust and Default Cooperation - Ethical Development and Ethical Judgment - Artificial Ethical Psychology.

(8)

USE TROLLEY AND ETHICAL OPT-OUT PROBLEM

A Hypothetical Case - Standard Trolley Cases - Other Cases - New and Old Threats - Particular Moral Issues in Self Driving Cars – Case studies - Passengers and Other Drivers - Introduction - Methodological Challenges - Second-Order Ethical Challenges.

(12)

REASONING PREFERENCES AND ETHICAL PRIORITIES IN AI SYSTEMS

Introduction - Background: Frameworks to Model Constraints and Preferences - Modeling Ethical Theories via Hard and Soft Constraints - Using CP-nets to Model Preferences and Ethical Priorities - A Notion of Distance between (Orderings Induced by) CP-nets - Using Distance to Support Ethical Decisions - Distance and Meta preference.

(8)

AUTONOMOUS WEAPONS AND ETHICS OF ARTIFICIAL INTELLIGENCE

Defining Autonomous Weapons - The Moral Problems Raised by Autonomous Weapons - Arguments for the Moral Desirability of Autonomous Weapons.

(5)

DESIGNING AI WITH RIGHTS, CONSCIOUSNESS, SELF-RESPECT, AND FREEDOM

Public policy and Super intelligent AI : The Prospect of Radically Transformative AI - A "Vector Field" Approach to Normative Analysis - The No- Relevant- Difference Argument and Its Two Central Parameters - Two Broad Moral Theories and the Ethical Precautionary Principle - The Puzzle of Consciousness and the Design Policy of the Excluded Middle - Cheerfully Suicidal AI Servants and the Self- Respect Design Policy – Case studies

(12)

TOTAL HOURS: 45

TEXTBOOKS

1. Y S. Matthew Liao, “Ethics of Artificial Intelligence”, First Edition, Oxford University Press,2020.
2. John C. Havens, “Heartificial Intelligence: Embracing Our Humanity to Maximize Machines”, Tarcher Perigee, 2016

REFERENCE

1. Mark Coeckelbergh, “AI Ethics”, The MIT Press, 2020.

19MAME02 – HEALTHCARE ANALYTICS

Contact Hours

L	T	P	C
2	0	2	3

ASSESSMENT: THEORY

PRE-REQUISITES
Consent of the instructor

COURSE OUTCOMES
CO1: To understand the various sources of healthcare data analyze it.
CO2: To gain a overall understanding about the electronic healthcare records.
CO3: To process the different types of healthcare data stored in health data sources.
CO4: To apply the appropriate biomedical image and text analysis techniques for analyzing biomedical image and clinical text data.
CO5: To generate the prediction health care model using temporal, sensor and text mining techniques.

INTRODUCTION
Introduction to Healthcare Data Analytics – Healthcare Data Sources and Basic Analytics - Advanced Data Analytics for Healthcare - Applications and Practical Systems for Healthcare - Resources for Healthcare Data Analytics.

(5)

HEALTHCARE DATA SOURCES AND BASIC ANALYTICS
Electronic Health Records: A Survey – History and components of EHR - Coding systems - Benefits of EHR – Challenging of Using EHR Data.

(4)

HEALTHCARE DATA ANALYTICS
Biomedical Image Analysis – Biomedical Imaging Modalities – Object Detection - Image Segmentation - Image Registration - Feature Extraction. Natural Language Processing and Data Mining for Clinical Text – Natural Language Processing - Mining Information from Clinical Text - Challenges of Processing Clinical Reports - Clinical Applications. Social Media Analytics for Healthcare – Social Media Analysis for Detection and Tracking of Infectious Disease Outbreaks - Social Media Analysis for Public Health Research - Analysis of Social Media Use in Healthcare.

(8)

ADVANCED DATA ANALYTICS FOR HEALTHCARE
Temporal Data Mining for Healthcare Data – Association Analysis, Temporal Pattern Mining - Sensor Data Analysis - Other Temporal Modelling Methods. Information Retrieval for Healthcare – Knowledge-Based Information in Healthcare and Biomedicine - Content of Knowledge-Based Information Resources – Indexing – Retrieval - Evaluation. Privacy-Preserving Data Publishing Methods in Healthcare – Data Overview and Pre-processing - Privacy-Preserving Publishing Methods - Challenges with Health Data

(8)

APPLICATIONS AND PRACTICAL SYSTEMS FOR HEALTHCARE
Fraud Detection in Healthcare, Mobile Imaging and Analytics for Biomedical Data – Image Formation, Data Visualization - Image Analysis - Image Management and Communication

(5)

PRACTICALS

Analysis of Healthcare (EHR) Data-Analysis of prescriptions-Social Media Analysis for Detection and Tracking of Infectious Disease Outbreaks-Analyzing healthcare images-Data Visualization of biomedical data.

(15)

TOTAL HOURS: 45

TEXTBOOK

1. Chandan K. Reddy and Charu C. Aggarwal, "HealthCare Data Analytics", CRC Press, 2015.

REFERENCES

1. Laura B. Madsen, "Data-Driven Healthcare: How Analytics and BI are Transforming the Industry", Wiley and SAS Business Series, 2014.
2. Trevor L. Strome, "Healthcare Analytics for Quality and Performance Improvement", John Wiley & Sons, Inc., 2013.
3. Surbi Bhatia, Ashutosh Kumar Dubey, Rita Chikara, Poonam Chaudhary, Abishek Kumar, "Intelligent Healthcare-Applications of AI in eHealth". EAI/Springer Innovations in Communication and Computing, 2021.

19MAME03 - SMART APPLICATIONS

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES

Consent of the Instructor

COURSE OUTCOMES

CO1: Provides Comprehensive understanding of Artificial Intelligence and Intelligent Systems in the context of Knowledge Engineering.

CO2: Recognize the technologies behind AI and software-defined network/network function virtualization, highlighting the exciting opportunities to integrate those two worlds.

CO3: To get familiar with the various applications of these techniques in manufacturing systems.

CO4: Highlights the avionics and satellite communication systems and aerospace platforms

CO5: Provide an invaluable resource for artificial intelligence, and machine learning researchers.

ARTIFICIAL INTELLIGENCE FOR INTELLIGENT SYSTEMS

Introduction – Intelligent Machines – Dark ages to Knowledge based systems-Neural Expert systems-ANFIS-– Models of Hybrid Computational Intelligence Architectures- Integrated Intelligent Systems - Neuro Fuzzy Systems- Evolutionary Fuzzy systems-EvoNF systems- Evolutionary Neural Network – General Framework Search of Connection weights- Architectures – Learning rules – Meta learning– Hybrid Evolutionary Algorithms.

(9)

ARTIFICIAL INTELLIGENCE FOR NETWORK AUTOMATION

Introduction- Generations of network transformation- From automation to AI- The role of artificial intelligence for network operations- zero-touch network - identifies SDN and AI are together providing the core technology and intelligences - Background overview of the tasks involved in operating a network- use of automation autonomous network run on data- Defined Network-Self-contained- self-optimizes-Software and hardware platforms-AI system architectures.

(9)

ARTIFICIAL INTELLIGENCE FOR MANUFACTURING SYSTEMS

Introduction - Traditional Manufacturing Systems - Changes in Manufacturing Systems: a Historical Perspective -Artificial Intelligence and Intelligent Manufacturing Systems - Technologies of Artificial Intelligence- Intelligent Manufacturing Systems- Properties of Intelligent Manufacturing Systems- Architecture of Intelligent Manufacturing Systems - Holonic Manufacturing Systems- Applications of Intelligent Manufacturing Systems.

(9)

ARTIFICIAL INTELLIGENCE FOR AEROSPACE

Planning - Applications of planning - Planning algorithms- The classical framework - STRIPS language and its extensions (ADL, PDDL...)- state - space search, plan-space search- GRAPHPLAN methods, SATPLAN and CSP-PLAN methods -Algorithmic Decision Theory ; Markov Decision - Processes Case study and Exercises Game Theory Formalization : Normal Form ; Pure and Mixed Strategies -Equilibrium (Nash, (iterated) Dominant Strategy Equilibrium) Algorithms -Condorcet Winner, Arrow's Theorem-Collective decision Applications.

(9)

ADVANCED TOPICS IN AI - PRESENT AND FUTURE

Introduction – AI and Concurrency – Agent-based Concurrent Engineering-Cloud computing and Intelligent Agents- Planning and logic –Business Intelligence and Analytics- Sentiment Analysis- Big data and sensory processing (SP) – Theory of Intelligence – Future of Intelligent Systems.

(9)

TOTAL HOURS: 45

TEXTBOOKS

1. Crina Grosan and Ajith Abraham , "Intelligent Systems: A Modern Approach (Intelligent Systems Reference Library)", Springer – Verlag Berlin Heidelberg, 2011.(Para I)
2. Mazin Gilbert, "Artificial Intelligence for Autonomous Networks", CRC press Publications, 2018.(Para II)
3. Parag Kulkarni and Prachi Joshi "Artificial Intelligence: Building Intelligent Systems", PHI Learning Private Limited, 2015. (Para III)
4. E. Oztemel, Lyes Benyoucef, Bernard Grabot , "Artificial Intelligence Techniques for Networked Manufacturing Enterprises Management", Springer-Verlag**,** 2010.(Para IV&V)

REFERENCES

1. Michael Negnevitsky "Artificial Intelligence A Guide to Intelligent Systems" , 2nd Edition Pearson Education Limited, 2005.
2. Martin Osborne, "Introduction to Game Theory", Oxford University Press, 2009.

19MAME04 - SPATIAL DATA MODELING AND ANALYSIS

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
Consent of the Instructor

COURSE OUTCOMES
CO1: Use the fundamental concepts of Geographic Information Science and Technology
CO2: Design Geo Spatial Database
CO3: Describe the geospatial system and represent various data models.
CO4: Analyze Geospatial data using spatial and raster analysis techniques.
CO5: Create and design principles, including thematic map display, map projections, and cartographic design

INTRODUCTION TO GIS
Introduction – GIS Components – GIS in Organizations. Data Models - Introduction – Common Spatial Data Models – Raster Data Models – Other Data Models – Data File and Structures. Geodesy, Datums, Map Projections and Coordinate Systems

(9)

DESIGNING GIS DATABASE WITH DIGITAL DATA
Maps, Data Entry, Editing and Output – Building GIS Database – Digitizing Coordinate capture – Coordinate
Transformation – Output : Maps – Data – Meta Data. Digital Data - Introduction –National and Global Digital Data. Tables

(9)

GEOSPATIAL NAVIGATION SYSTEM AND DATA MODEL
Global Satellite Navigation System and Coordinate Surveying - Introduction – Differential Correction – Optical and Laser Coordinate Surveying – GNSS Applications. Aerial and Satellite Images - Basic Principles – Aerial Images – Satellite Images – Air born LiDAR

(9)

SPATIAL AND RASTER ANALYSIS
Basic Spatial Analysis - Introduction – Selection and Classification – Dissolve – Proximity Functions and Buffering – Overlay – Network Analysis. Topics in Raster Analysis - Map Algebra – Local Functions – Neighborhood, Zonal and Global Functions. Terrain Analysis

(9)

SPATIAL MODELING AND ESTIMATION
Spatial Estimation: Interpolation, Prediction, Core Area - Sampling – Spatial Interpolation Methods – Spatial Prediction –Core Area Mapping. Spatial Models and Modelling - Cartographic Modeling. Data Standards and Data Quality. New Developments in GNSS – GNSS – Datum Modernization–Improved Remote Sensing – Cloud Based GIS–Open GIS

(9)

TOTAL HOURS: 45

TEXTBOOK

1. Paul Bolstad, “GIS Fundamentals: A First Text on Geographic Information Systems”, 6th edition, 2019

REFERENCES

1. Robert Haining, “Spatial Data Analysis Theory and Practice”, Cambridge University, 2010.
2. Jay Gao, “Fundamentals of Spatial Analysis and Modelling”, CRC Press, 2021.

19MAME05 – AUGMENTED AND VIRTUAL REALITY

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
Consent of the Instructor

COURSE OUTCOMES
CO1: Learn the fundamentals of Augmented Reality(AR)
CO2: Implement AR tools and predict the approximate future direction of Mixed Reality.
CO3: Explore the concept of Virtual Reality
CO4: Demonstrate appropriate perceptual model for building a virtual reality system
CO5: Design various stages for Virtual reality process

INTRODUCTION TO AUGMENTED REALITY(AR)
Definition of Augmented Reality-Components of Augmented Reality-History of Augmented Reality-Augmented Reality vs Virtual Reality - Challenges with AR - Opportunities for Augmented Reality- Types of Augmented Reality - Augmented Reality Methods - AR Display Technology - Interaction in AR Applications.

(11)

INNOVATORS AND ORGANIZATIONS
Innovators and Organizations- Innovators in AR- Companies Specializing in AR- AR Tools- AR Blogs- Visions of the Future- The Big Trends- Technical Trends- Future Concepts for Augmented Reality.

(9)

VIRTULA REALITY(VR)
Introduction to VR: Definition of Virtual Reality-History of VR- Overview of Various Realities-Immersion, Presence and Reality Trade-Offs- Design Guidelines.

(9)

PERCEPTION
Objective and Subjective Reality-Perceptual Models and Processes: Distal and Proximal Stimuli-Sensation versus Perception - Bottom-Up and Top-Down Processing-Perceptual Modalities: Sight-Hearing-Touch-Proprioception-Balance and Physical Motion.

(10)

ITERATIVE DESIGN
Philosophy of Iterative Design-The Define Stage- The Make Stage: Task Analysis- Design Specification-System Considerations-Simulation-The Learn Stage.

(8)

TOTAL HOURS:45

TEXTBOOKS

1. Gregory Kipper, Joseph Rampolla Chris Katsaropoulos "Augmented Reality-An Emerging Technologies Guide to AR", 2013. [Para I, II]
2. Jason Jerald, "The VR Book-Human-Centered Design for Virtual Reality", ACM Books, 2016 [Para III, IV, V]

REFERENCES

1. John Vince, “Virtual Reality Systems”, Pearson Education, 2002
2. Paul Mealy, “Virtual & Augmented Reality for Dummies”, Kindle Publication, 2018

19MAME06 - MEDICAL IMAGE PROCESSING

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISTES
19MAME17

COURSE OUTCOMES
CO1: Understand the fundamentals of medical imaging techniques
CO2: Learn various noise reduction filters and feature extraction for medical data analysis.
CO3: Apply various image restoration techniques on medical image data.
CO4: Familiarize with the bio-medical image segmentation methods
CO5: Use machine learning methods on MRI data to derive insights.

INTRODUCTION TO MEDICAL IMAGES
Digital Image-Components-Vision Fundamentals-Modalities of Medical Imaging-Problems-Image Enhancement Methods-Radiography-PET-CTA-Echocardiogram.

(9)

NOISE REDUCTION FILTERS AND FEATURE EXTRACTION
Spatial Domain Filters-Frequency Domain Filters-Selection of Features-Space Related Features-Texture Analysis-Analysis of Tissue Structure.

(9)

MEDICAL IMAGE RESTORATION
Image Restoration-Degradation Model-Estimation of Degradation Function-Blur Model-Blur Identification-Image Restoration Techniques-Applications.

(8)

BIOMEDICAL IMAGE SEGMENTATION
Points Detection-Line Detection-Edge Detection and Methods-Histogram Based-Split and Merge Method-Region Growing Method-k-Means Clustering Method

(10)

BIG DATA and Magnetic Resonance Imaging
Magnetic Resonance Imaging Techniques: MRI Signal Types-Machine Learning for Structural and Functional Imaging Data.

(9)

TOTAL HOURS:45

TEXTBOOKS

1. G.R. Sinha, Bhagwati Charan Patel, “Medical Image Processing”, PHI India, 2014.
2. Ervin Sejdic, Tiago H.Falk, “Signal Processing and Machine Learning for Biomedical Big Data, CRC,Press,2018.(Para V).

REFERENCES

1. AtamP.Dhawan, ‘Medical Image Analysis’, Wiley Interscience Publication, 2003.
2. KavyanNajarian and Robert Splerstor,” Biomedical signals and Image processing”,CRC,2006.

19MAME07 – NATURAL LANGUAGE PROCESSING

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
19MAM51,19MAM62

COURSE OUTCOMES
CO1: Learn and understand the fundamental units of language and its models.
CO2: Use vector semantics and implement vector models for texts.
CO3: Design and develop NLP systems using machine learning models like Naïve Bayes, Neural Networks.
CO4: Use Hidden Markov Model and Conditional Random fields in tagging parts-of-speech tagging
CO5: Apply the principles of deep learning techniques to process speech and texts based applications.

REGULAR EXPRESSIONS AND NORMALIZATION
Introduction - Regular Expressions-words – Corpora – Text Normalization – Minimum edit distance – N gram Language Models: N-Grams - Evaluating Language Models- Sampling sentences from a language model- Generalization and Zeros- Smoothing- Kneser-Ney Smoothing- Huge Language Models and Stupid Backoff- Advanced: Perplexity's Relation to Entropy

(8)

VECTOR SEMANTICS AND EMBEDDINGS
Lexical Semantics-Vector Semantics-Words and Vectors-Cosine for Measuring Similarity-TF-IDF-Pointwise Mutual Information (PMI)-Applications of TF-IDF and PMI-Word2vec: Visualizing Embeddings-Semantic Properties of Embeddings-Evaluating Vector Models

(7)

NAIVE BAYES AND SENTIMENT CLASSIFICATION
Naive Bayes Classifiers - Training the Naive Bayes Classifier-Worked Example-Optimizing for Sentiment Analysis - Naive Bayes for other text classification tasks-Naive Bayes as a Language Model - Evaluation: Precision, Recall, F-measure - Test sets and Cross-validation - Statistical Significance Testing - Avoiding Harms in Classification-Applications.

(7)

NEURAL NETWORKS AND NEURAL LANGUAGE
Overview of Feedforward Neural Networks-Feedforward networks for NLP: Classification-Feedforward Neural Language Modelling-Training Neural Nets-Training the neural language model-Applications.

(7)

SEQUENCE LABELLING FOR PARTS OF SPEECH NAMED ENTITIES
English Word Classes- Parts of Speech Tagging-Named Entities and Named Entity Tagging. HMM parts of Speech Tagging: Markov Chains-Hidden Markov Model-Components of HMM tagger-HMM tagging as decoding-Viterbi Algorithm-Example. Conditional Random Fields (CRFs): Features in CRF

POS Tagger-Features for POS Named Entities Recognizers-Inference and Training for CRFs-Evaluation of Named Entity Recognition.

(8)

DEEP LEARNING ARCHITECTURES FOR SEQUENCE PROCESSING

Overview of Recurrent Neural Networks (RNN)-RNNs as Language Models-RNNs for other NLP tasks-Stacked and Bidirectional RNN architectures-LSTM- Transformers as Language Models-Contextual Generations and Summarization. Machine Translation: Language Divergences and Typology-Encoder Decoder Models with RNNs.

(8)

TOTAL HOURS:45

TEXTBOOK

1. Jurafsky and Martin, “Speech and Language Processing”, Pearson, 2022

REFERENCES

1. Manning and Schutze, "Foundations of Statistical Natural Language Processing" MIT Press Cambridge, MA, 1999.
2. Denis Rothman “Transformers for Natural Language Processing”,Packt, 2021

19MAME08 - PROBABILISTIC GRAPHICAL MODELS

Contact Hours

L	T	P	C
2	0	2	3

ASSESSMENT: THEORY

PRE-REQUISITES:
19MAM13, 19MAM22,19MAM47

COURSE OUTCOMES
CO1: Understand the mathematical framework of probabilistic graphical models
CO2: Apply various representation models
CO3: Understand the basic concepts of probabilistic inference in graphical models
CO4: Apply the inference of Probabilistic models
CO5: Familiarize with the learning process of graphical models like Bayesian and Hidden Markov Model.
CO6: Implement Probabilistic graphical Models and draw inference for real world problems using Python libraries

FOUNDATIONS
Structured Probabilistic Models – Foundations: Probability Theory – Graphs. Bayesian Network Representation: Exploiting Independence Properties – Bayesian Networks – Independencies in Graphs – From Distributions to Graphs.

(5)

UNDIRECTED GRAPHICAL MODELS
Parameterization -Markov Network Independencies – Parameterization Revisited – Bayesian Networks and Markov Networks – Partially Directed Models.

(5)

LOCAL PROBABILISTIC MODELS
Tabular CPDs – Deterministic CPDs – Context-Specific CPDs – Independence of Causal influence – Continuous Variables – Conditional Bayesian Networks. Gaussian Network Models: Multivariate Gaussians – Gaussian Bayesian Networks – Gaussian Markov Random Fields.

(6)

INFERENCE
Analysis of Complexity- Variable Elimination – Complexity and Graph Structure-Conditioning – Inference with Structured CPDs. Variable Elimination and Clique Trees – Message Passing: Sum Product – Message Passing : Belief Update – Constructing a Clique Tree

(6)

LEARNING GRAPHICAL MODELS
Goals of Learning – Learning as Optimization – Learning Tasks. Structure Learning in Bayesian Networks: Constraint-based Approaches – Structure Scores – Structure Search – Bayesian Model Averaging – Learning Models with Additional Structure. Specialized Models: Naïve Bayes and Hidden Markov Model.

(8)

PRACTICALS
Problems based on the above modules using Python library pgmpy and Tensorflow.

(15)

TOTAL HOURS: 45

TEXTBOOKS

1. Daphne Koller and Nir Friedman, “Probabilistic Graphical Models Principles and Techniques”, MIT Press, Cambridge, Massachusetts, Lond, 2009.
2. Ankur Ankan and Abinash Panda, “Mastering Probabilistic Graphical Model in Python”, Packt,2015. (Practicals)

REFERENCES

1. Qiang Ji, “Probabilistic Graphical Models for Computer Vision”, First Edition, Elsevier, 2019.
2. Luis Enrique Sucar, “Probabilistic Graphical Model”, Springer, 2015.

19MAME09 - COGNITIVE COMPUTING

CONTACT HOURS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES

Consent of the instructor

COURSE OUTCOMES

CO1: Learn and understand the basics concepts of cognitive computing and its applications.

CO2: Identify the building blocks of a cognitive system and use it to design cognitive system for various business requirements.

CO3: Determine the role of NLP and knowledge representation in cognitive systems.

CO4: Build a complete cognitive system and test it successfully

CO5: Familiarize with the latest trends and case studies on cognitive computing systems.

FOUNDATIONS OF COGNITIVE COMPUTING

Cognitive Computing as a New Generation-Uses of Cognitive Systems-Characteristics of a Cognitive System-Domains of Cognitive Computing-Artificial Intelligence as the Foundation of Cognitive Computing-Understanding Cognition-Two Systems of Judgment and Choice-Understanding Complex Relationships Between Systems-Types of Adaptive Systems-Elements of a Cognitive System-Infrastructure and Deployment Modalities-Data Access, Metadata, and Management Services-Data Analytics Services-Continuous Machine Learning-Hypothesis Generation and Evaluation-The Learning Process-Presentation and Visualization Services-Cognitive Applications.

(8)

DESIGN PRINCIPLES AND BUSINESS IMPLICATIONS

Components of a Cognitive System-Building the Corpus-Corpus Management Regulatory and Security Considerations-Bringing Data into the Cognitive System-Leveraging Internal and External Data Sources-Data Access and Feature Extraction Services-Analytics Services-Infrastructure.

Preparing for Change-Advantages of New Disruptive Models-The Difference with a Cognitive Systems Approach-Using Business Knowledge to Plan for the Future-Answering Business Questions in New Ways-Building Business Specific Solutions-Making Cognitive Computing a Reality.

(8)

NATURAL LANGUAGE PROCESSING IN COGNITIVE COMPUTING

The Role of NLP in a Cognitive System: Context-Connecting Words for Meaning-Understanding Linguistics-Language Identification and Tokenization-Phonology-Morphology-Lexical Analysis-Syntax and Syntactic Analysis-Construction Grammars-Discourse Analysis-Pragmatics-Techniques for Resolving Structural Ambiguity-Importance of Hidden Markov Models-Word-Sense Disambiguation (WSD)-Semantic Web-Applying Natural Language Technologies-to Business Problems: Enhancing the Shopping Experience-Leveraging the Connected World of Internet of Things-Voice of the Customer-Fraud Detection.

(9)

REPRESENTING KNOWLEDGE IN TAXONOMIES AND ONTOLOGIES

Representing Knowledge-Developing a Cognitive System: Defining Taxonomies and Ontologies-Representing Knowledge-Managing Multiple Views of Knowledge-Models for Knowledge Representation-Taxonomies, Ontologies, Other Methods of Knowledge Representation: Simple Trees-Persistence and State-Implementation Considerations.

(7)

BUILDING A COGNITIVE APPLICATION

The Emerging Cognitive Platform-Defining the Objective, Domain, Users and Attributes-Exploring Insights-Typical Question-Answer Pairs-Anticipatory Analytics-Acquiring the Relevant Data Sources-Importance of Leveraging Structured Data Sources-Analyzing Dark Data -Leveraging External Data-Creating and Refining the Corpora-Preparing the Data-Ingesting the Data-Refining and Expanding the Corpora-Governance of Data-Training and Testing.

(7)

EMERGING COGNITIVE COMPUTING APPLICATIONS

Characteristics of Ideal Markets for Cognitive Computing-Vertical Markets and Industries-Retail-Travel-Transportation and Logistics-Telecommunications-Security and Threat Detection-Other Areas That Are Impacted by a Cognitive Approach.

Case Studies: IBM'S Watson as a Cognitive System- Building a Cognitive Healthcare Application-Smarter Cities: Cognitive Computing in Government.

(6)

TOTAL HOURS: 45

TEXTBOOK

1. Judith S. Hurwitz, Marcia Kaufman, Andrian Bowles, "Cognitive Computing and Big Data Analytics", Wiley Publications, 2015

REFERENCES

1. Pradeep Kumar Mallick, Samarjeet Borah, "Emerging Trends and Applications in Cognitive Computing", IGI Global,2019.
2. Rob High, Tanmay Bakshi, "cognitive Computing with IBM Watson, Packt Publishers, 2019.

19MAME10- RECOMMENDER SYSTEMS

Contact Hours

L	T	P	C
2	0	2	3

ASSESSMENT: THEORY

PRE-REQUISITES
19MAM42

COURSE OUTCOMES
CO1: Familiarize with the basics concepts and applications of recommender systems.
CO2: Review the different methods of neighborhood based collaborative filtering.
CO3: Demonstrate the use of machine learning models for collaborative filtering.
CO4: Examine content based and knowledge-based systems and its categories to build recommender systems.
CO5: Develop new Recommender Systems for a number of domains like, Education, Health-care etc and evaluate its performance.

INTRODUCTION TO RECOMMENDER SYSTEMS
Goals-Applications-Basic Models of Recommender Systems-Domain Specific Challenges-Advanced topics and applications.

(5)

NEIGHBOURHOOD BASED COLLABORATIVE FILTERING
Key Properties of Rating Matrices-Predicting Ratings with Neighborhood Based Methods-Clustering and Neighborhood Based Methods-Dimensionality Reduction and Neighborhood Methods-Regression Modelling View of Neighborhood Methods-Graph Models for Neighborhood Based Methods.

(6)

MODEL BASED COLLABORATIVE FILTERING
Extending Decision Trees for Collaborative Filtering-Rule Based Filtering-Naïve Bayes Collaborative Filtering-Latent Factor Models.

(6)

CONTENT AND KNOWLEDGE BASED RECOMMENDER SYSTEMS
Preprocessing and Feature Extraction-Learning User Profiles and Filtering-Content Based vs Collaborative Filtering-Using Content Based Models for Collaborative Filtering. Constraint Based Systems-Case Based Recommenders

(7)

EVALUATING RECOMMENDER SYSTEMS
Evaluation Paradigms-Goals of Evaluation Design. Evaluation Metrics for Offline Recommender Systems.

(6)

PRACTICALS
Predicting Ratings with Neighborhood Based Methods-Clustering and Neighborhood Based Methods-Regression Modelling View of Neighborhood Methods-Graph Models for Neighborhood Based Methods-Implement Collaborative Filtering Algorithms-Applications of Recommender Systems such as Recommending movies, music, books, websites, etc.

(15)

TOTAL HOURS: 45

TEXTBOOKS

1. Charu C.Aggarwal, “Recommender Systems”, Springer, 2016.
2. Rounak Banik, “Hands on Recommender System Using Python, Packt, 2019 (Practicals)

REFERENCES

1. Kim Falk, “Practical Recommender Systems”, Manning Publications,2019.
2. Frank Kane, “Building Recommender System with Machine Learning and AI”,2018.
3. Michael Schrage,“ Recommendation Engines”, 2020.

19MAME11 - ROBOTICS AND ITS APPLICATIONS

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
19MAM12, 19MAM21

COURSE OUTCOMES
CO1: Learn the basic components and building blocks of Robots.
CO2: Develop the robot construction skills.
CO3: Acquire skills to program the robots.
CO4: Integrate the features and operations of automation products
CO5: Explore the broad scope of robotic applications

FUNDAMENTALS OF ROBOTICS
Robot Meaning – History of Robots – Classification of Robots - Fundamentals of Robot Technology, Programming, and Applications - Robot Anatomy - Robot Drive Systems - Control Systems - Precision of Movement - End Effectors - Robotic Sensors - Robot Programming and Work Cell Control - Robot Applications

(9)

ROBOT TECHNOLOGY: THE ROBOT AND ITS PERIPHERALS
Control Systems and Components - Basic Control Systems Concepts and Models – Controllers - Control System Analysis - Robot Sensors and Actuators - Velocity Sensors - Actuators - Power Transmissions Systems - Modeling and Control of a Single Joint Robot

(9)

ROBOT PROGRAMMING AND LANGUAGES
Robot Programming - Methods of Robot Programming – Lead through Programming Methods - A Robot Program as a Path in Space - Motion Interpolation - Wait, Signal, and Delay Commands – Branching. Robot Languages – Artificial Intelligence

(9)

APPLICATIONS ENGINEERING FOR MANUFACTURING
Robot Cell Design and Control - Robot Cell Layouts - Multiple Robots and Machine Interference - Other Considerations in Workcell Design - Workcell Control - Interlocks - Error Detection and Recovery - The Workcell Controller - Robot Cycle Time Analysis. Economic Analysis for Robotics - Economic Analysis: Basic Data Required - Methods of Economic Analysis - Subsequent use of the Robot - Differences in Production Rates - Robot Project Analysis Form.

(9)

ROBOT APPLICATIONS IN MANUFACTURING
Material Transfer and Machine Loading/Unloading - General Considerations in Robot Material Handling - Material Transfer Applications - Machine Loading and Unloading. Processing Operations - Spot Welding - Continuous Arc Welding - Spray Coating - Other Processing Operations using Robots. Assembly and Inspection

(9)

TOTAL HOURS: 45

TEXTBOOKS

1. Mikell P Groover, Mitchel Weiss, Roger N Nagel, Nicholas G Odrey, Ashish Dutta, “Industrial Robotics Technology, Programming and Applications", 2nd Edition, 2012. (Para I-V)
2. S.K. Saha, “Introduction to Robotics”, Tata McGraw Hill Education, 4th Edition, 2011. (Para - I)

REFERENCES

1. Danny Staple, “Learn Robotics Programming: Build and Control AI-enabled Autonomous Robots Using the Raspberry Pi and Python”, Packt Publishing, 2nd Edition, 2021
2. Robert J. Schilling, “Fundamentals of Robotics, Analysis & Control", PHI Learning, 2010.
3. Robin R. Murphy, “Introduction to AI Robotics”, Prentice, Hall of India, New Delhi, 2007.

19MAME12 - CONVERSATIONAL AI

Contact Hours

L	T	P	C
3	0	0	3

ASSESMENT: THEORY

PRE-REQUISITES
19MAME07

COURSE OUTCOMES
CO1: Understand the basics of a dialogue system.
CO2: Learn rules to develop dialogue systems.
CO3: Develop statistical data driven dialogue systems
CO4: Design and evaluate the dialogue systems.
CO5: Explore the challenges and future scope.

INTRODUCTION TO DIALOGUE SYSTEMS
Dialogue Systems – History of Dialogue Systems – Present Day Dialogue Systems – Modeling Conversation – Designing and Developing Dialogue Systems

(8)

RULE BASED DIALOGUE SYSTEMS: ARCHITECTURE, METHODS, TOOLS
Typical Dialogue Systems Architecture – ASR, NLU, Dialogue Management, NLG, TTS – Designing a Dialogue System, Tools for Developing Dialogue Systems – Visual Design Tools, Scripting Tools for Handcrafting Dialogue System, Advanced Toolkits and Frameworks, Research Based Toolkits

(9)

STATISTICAL DATA-DRIVEN DIALOGUE SYSTEMS
Motivating the Statistical Data Driven Approach – Dialogue Components – Natural Language Understanding – Dialogue Management – Natural Language Generation – Reinforcement Learning – Representing Dialogue a Markov Decision Process – From MDPs to POMDPs – Dialogue State Tracking – Dialogue Policy – Problems and Issues

(10)

EVALUATING DIALOGUE SYSTEMS
Conducting Evaluation – Evaluating Task-Oriented Dialogue Systems – Evaluating Open-Domain Dialogue Systems – Evaluation Frameworks – PARADISE, QoE, Interaction Quality

(9)

CHALLENGES AND FUTURE DIRECTIONS
Multimodality in Dialogue – Visual Dialogue and Visually Grounded Language – Data Efficacy – Reasoning and Collaborative Problem Solving in Dialogue Systems – Hybrid Dialogue Systems – Dialogue with Social Robots – Dialogue and the Internet of Things – Social and Ethical Issues

(9)

TOTAL HOURS: 45

TEXTBOOK
1. Michael F. McTear – "Conversational AI: Dialogue Systems, Conversational Agents and Chatbots", Morgan & Claypool Publishers, 2021.

REFERENCES

1. Andrew R. Freed, “Conversational AI”, Manning Publications, 2021
2. Srini Janarthanam, “Hands-On Chatbots and Conversational UI Development: Build chatbots and Voice User Interfaces with Chatfuel, Dialogflow, Microsoft Bot Framework, Twilio, and Alexa Skills”, Packt Publishing, 2017

19MAME13 – GAME THEORY

CONTACT HOURS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
Consent of the Instructor

COURSE OUTCOMES
CO1: Model a 2 x2 evolutionary games in dynamical systems.
CO2: Develop model for applications using Network reciprocity
CO3: Analyse the evolution of communication in Constructivism Approach
CO4: Design and perform Cellular Automaton Model in realistic Traffic flow
CO5: Examine pandemic analysis as application to which evolutionary game theory can be applied.

EVOLUTIONARY GAME THEORY AND ITS FUNDAMENTALS
Modeling a Real Complex World - Modeling a Real Complex World - Fundamental Theory for Evolutionary Games: Linear Dynamical Systems - Non-linear Dynamical Systems - 2-Player & 2-Stratey Games - Dynamics Analysis of the 2 x 2 Game - Multi-player Games - Social Viscosity; Reciprocity Mechanisms - Universal Scaling for Dilemma Strength in 2 x 2 Games – R- Universal Scaling for Dilemma Strength in 2 x 2 Games.

(12)

NETWORK RECIPROCITY
Most Influential to Enhance Network Reciprocity - Model Description - Effect of the Initial Fraction of Co-operators on Cooperative Behavior in the Evolutionary Prisoner's Dilemma Game - Several Applications of Stronger Network Reciprocity - Discrete, Mixed and Continuous Strategies Bring Different Pictures of Network Reciprocity – A Substantial Mechanism of Network Reciprocity

(10)

EVOLUTION OF COMMUNICATION
Communication as an Authentication Mechanism - An Evolutionary Hypothesis Suggested by Constructivism Approach

(6)

TRAFFIC FLOW ANALYSIS
Modelling and Analysis of the Fundamental Theory of Traffic Flow - A Cellular Automaton (CA) Model to Reproduce Realistic Traffic Flow - Social Dilemma Structure Hidden Behind Various Traffic Contexts

(9)

PANDEMIC ANALYSIS AND EVOLUTIONARY GAMES
Modeling the Spread of Infectious Diseases and Vaccination Behavior - Vaccination Games in Complex Social Networks.

(8)

TOTAL HOURS:45

TEXTBOOK

1. Jun Tanimoto, "Fundamentals of Evolutionary Game Theory and its Applications", Springer 2016

REFERENCES

1. Michael Maschler, Eilon Solan, Shmuel Zamir, “Game Theory”, Cambridge University Press, 2013
2. Martin Osborne, “An Introduction to Game Theory”, Oxford University Press, 2003

19MAME14 - AGILE SOFTWARE DEVELOPMENT

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PREREQUISITES
Consent of the Instructor

COURSE OUTCOMES
CO1: Understand the key principles of agile management.
CO2: Learn agile Project Management process and agile project planning.
CO3: Apply agile development management and product management in system development.
CO4: Identify the need for scrum and use scrum tools.
CO5: Compare scrum with conventional project management and waterfall methods.

TRADITIONAL SOFTWARE DEVELOPMENT AND AGILE
Traditional Software Development – History of Project Management – Waterfall Approach – Project Management Triangle – Modified Waterfall Models. Overview of Agile Software Development – Lean Software Development – Project Management 2.0 – Agile Manifesto – Scrum – Test Driven Development – Extreme Programming – Rational Unified Process - Agile Unified Process – Agile Model Driven Development

(7)

AGILE PROJECT MANAGEMENT AND PLANNING
Software Production Metrics - Agile Project Management - Agile Project Planning - The Agile Manager's New Work - Considerations on Teaming and Leadership - Considerations on Planning and Architecture.

(7)

AGILE DEVELOPMENT MANAGEMENT AND PRODUCT MANAGEMENT
Agile Development Management – Software Resource Planning – An Agile Maturity Model – Setting the Governing Rules – Staffing Decisions – Operations Review – Agile Product Management – Financial Metrics for Software Services – Business Benefit of Agile Methods - Considerations on Project Execution.

(10)

FOUNDATIONS OF SCRUM
Need for Scrum- Scrum Team – Agile Product or Process Development – Eliminate Waste and Save Money – Improved Control or Assurance – Schedule and Budget Maintenance – Managing Changing User Requirements – Projects Candidates for Scrum. Overview of Scrum principles– Requirements – Product Backlog – Planning and Estimation – Release Backlog – Sprint – Sprint Retrospective – Iterative Product Delivery – Burndown Chart and Scope Changes – Meetings – Project Human Resources.

(12)

SCRUM AND PROJECT MANAGEMENT
Scrum and Conventional Project Management – Complex Project Management – Scrum and the Waterfall Method. Case Study: Scrum and Education – Scrum and Hospitals. **Agile Tools :** Scrumblr, Trello, Yodiz, ScrumDesk.

(9)

TOTAL HOURS: 45

TEXTBOOKS

1. Thomas Stober, Uwe Hansmann, “Agile Software Development - Best Practices for Large Software Development Projects”, Springer, June 2009. (Para I, II, III)
2. David J. Anderson and Eli Schragenheim, “Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results”, Prentice Hall, 2003. (Para II, III)
3. Kim H. Pries, Jon M. Quigley, “Scrum Project Management”, CRC Press, 2011. (Para IV,V)

REFERENCES

1. Sudipta Malakar, “Agile Methodologies In – Depth: Delivering Proven Agile, SCRUM and Kanban Practices for High – Quality Business Demands”, BPB Pubilcations, 2021
2. Mike Cohn, “Succeeding with Agile: Software Development Using Scrum”, Addison Wesley, 2010.
3. Robert C. Martin ,”Agile Software Development, Principles, Patterns, and Practices”, Alan Apt Series,2011.

19MAME15 - SOA AND WEB SERVICES

Contact Hours

L	T	P	C
2	0	2	3

ASSESSMENT: THEORY

PRE-REQUISITES
Consent of the instructor

COURSE OUTCOMES
CO1: Examine the requirements of distributed applications and design web services.
CO2: Apply the concepts of Service Oriented Architecture in designing platform independent real time distributed applications.
CO3: Design and develop simple to complex web services that meet the specified requirements.
CO4: Develop web services based on requirements of the web application using Java APIs and also consume them in web applications.
CO5: Determine the security requirements of web services and incorporate them in building web applications.

INTRODUCTION TO SOA
Introducing SOA: Fundamental SOA - Common Characteristics of Contemporary SOA – Common Misperceptions about SOA – Common Tangible Benefits of SOA – Common Pitfalls of Adopting SOA - Evolution of SOA

(5)

WEB SERVICES AND SOA
Web Services and Primitive SOA: The Web Service Framework - Services (as Web Services) - Service Descriptions (with WSDL) - Messaging (with SOAP); Web Services and Contemporary SOA (Part I: Activity Management and Composition): Message Exchange Patterns - Service Activity - Coordination - Atomic Transactions - Business Activities – Orchestration – Choreography

(7)

SOA AND SERVICE-ORIENTATION
Principles of Service-Orientation: Anatomy of a Service-Oriented Architecture - Common Principles of Service-Orientation – How Service-Oriented Principles Inter-relate; Service Layers.

(6)

BUILDING SOA
Service Oriented Analysis: Introduction – Service Modelling Guidelines; Service Oriented Design: Introduction to Service-Oriented Design, WSDL-Related XML Schema Language Basics - WSDL Language Basics - SOAP Language Basics, SOA Composition Guidelines,
Service Design: Service Design Overview, Business Process Design: WS-BPEL Languages Basics - WS-Coordination Overview - Service-Oriented Business Process Design; Fundamental WS-* Extensions: WS-Security Language Basics.

(6)

WEB SERVICES IN JAVA
Building Web Services with JAX-WS - Binding between XML Schema and Java Classes – Streaming API for XML - SOAP with Attachments API for Java - Generating Client-Support Code from a WSDL - Building RESTful Web Service with JAX-RS.

(6)

PRACTICALS

Modelling the business services-Implement the Service Interface and Service Implementation Classes - Write WSDL document to describe services-Publish web services. Create Web Service Client-Create and send messages using SOAP Attachment API. Build RESTful APIs and Microservices using Flask/Django **(15)**

TOTAL HOURS: 45

TEXTBOOKS

1. Thomas Eri, "Service-Oriented Architecture- Concepts, Technology and Design", Pearson Education, Second Edition, 2008. (Para I to IV)
2. Eric Jendrock, Jennifer Ball, Debbie Carson, Ian Evans and Kim Haase, "The Java EE5 Tutorial", Oracle Corporation Press, 2010 (Para V)

REFERENCES

1. Gaston C. Hillar, “Hands-On RESTful Python Web Services”,Packt,2018.
2. Martin Kalin, "Java Web Services: Up and Running", O'Reily Media Inc., First Edition, 2009.
3. Eric Newcomer, Greg Lemow, “Understanding SOA with Web Services”, Pearson Education, Inc, 2005.

19MAME16 – INTERNET OF THINGS

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
Consent of the instructor

COURSE OUTCOMES
CO1: Assess the different IoT technologies that suits an application.
CO2: Recognize the challenges for smart object.
CO3: Demonstrate knowledge of main architectures and paradigms for the Internet of Things.
CO4: Demonstrate knowledge of MAC and routing protocols developed for Low Power and lossy networks.
CO5: Design simple IoT systems for the given requirements comprising sensors- edge devices- wireless network connections and data analytics capabilities.

INTRODUCTION
Definition and Characteristics of IoT - Physical Design of IoT - Logical Design of IoT – Enabling Technologies - IoT Levels - Domain specific IoTs

(5)

SENSORS- PARTICIPATORY SENSING- RFIDS AND WIRELESS SENSOR NETWORK
Introduction-Sensor technology - Sensing the real world-Analog sensors- Examples of sensors – Reading temperature from Resistance sensor- capacitive sensor-Examples of sensors-Temperature-humidity-distance light-acceleration-vibrations and shocks-Gyroscope for angular acceleration- Magnetic sensors-Magnetometer Sound -Sensing the Things-bar code-QR code- Motion sensors-Pressure sensors-Location and LIDAR-Industrial IoT - in bicycle manufacturing process and Automotive IoT - Connected cars technology

(10)

DEVELOPING INTERNET OF THINGS
IoT and M2M - IoT System Management with NETCONF-YANG - IoT Design Methodology - Case Study: Weather monitoring - Motivation for using Python- Logical design using Python: Programming constructs - Python packages for IoT

(6)

IOT PHYSICAL DEVICES AND ENDPOINTS
Building Blocks of an IoT device - Intel Galileo Board - Raspberry pi

(6)

IOT CLOUD BASED SERVICES USING THE XIVELY- NIMBITS
Cloud storage models and communication API - WAMP-AutoBahn for IoT - Xively cloud for IoT - Django -Designing a RESTful Web API - Amazon Web services for IoT- Data collection-storage-Computing using Xively and Nimbits- Data channels using advanced features-security tokens-Alerts-Jabbing-Subscriptions-Public cloud IoT platforms like Paas and SaaS

(10)

DATA ANALYTICS FOR IOT

Apache Hadoop - Using map-reduce for batch data analytics

(4)

CASE STUDIES ILLUSTRATING IoT DESIGN

Home Automation - Cities - Environment - Agriculture - Productivity Applications

(4)

TOTAL HOURS: 45

TEXTBOOK

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things: A Hands-on Approach”, Universities Press, 2014.

REFERENCES

1. Andy King, “Programming the Internet of Things: An Introduction to Building Integrated Device-to-Cloud IOT Solutions”, O’Reilly, 2021
2. Agus Kuniawa, “Getting started with Intel IoT and Intel Galileo”, Kindle edition, 2015.
3. Raj Kamal, “Internet of Things - Architecture and Design Principles”, McGraw Hill,2017

19MAME17 – DIGITAL SIGNAL AND IMAGE PROCESSING

Contact Hours

L	T	P	C
2	0	2	3

ASSESSMENT: THEORY

PRE-REQUISITES:
Consent of the Instructor

COURSE OUTCOMES
CO1: Learn the basic concepts of Signals and Images
CO2: Illustrate various filtering methods.
CO3: Evaluate continuous and discrete spectra estimation
CO4: Understand steps in image processing such as Image perception and sensing
CO5: Explore Image estimation and restoration methods.

DETERMINISTIC SIGNALS
Signal Fundamentals: The concept of signal – The concept of system – Discrete Time Signals and sampling: The sampling theorem – Plotting a signal as a function of time – Spectral representation – Fast Fourier Transform

(8)

LINEAR FILTERS
Definitions and properties – The z-transform – Transforms and linear filtering – Different equations and rational TF filters – Minimum phase filters – Filter Design methods – Oversampling and Undersampling.

(8)

CONTINUOUS SPECTRA ESTIMATION
Non-parametric estimation of the PSD – Parametric estimation – Discrete Spectra Estimation: Estimating the amplitudes and the frequencies – High resolution methods

(9)

IMAGE PERCEPTION AND SENSING
Light and Luminance – Still Image Visual Properties – Time-variant Human Visual System Properties – Color - Color spaces – Image Sensors and Displays – Image Enhancement and Analysis: Simple Image processing filters – Image Enhancement – Image Analysis – Object detection.

(10)

IMAGE ESTIMATION AND RESTORATION
Two Dimensional random fields – Estimation for Random fields – Two-Dimensional Recursive Estimation - Inhomogeneous Gaussian Estimation – Estimation in the Sub band or Wavelet Domain – Bayesian and Maximum A Posteriori Estimation - Image Identification and Restoration.

(10)

PRACTICALS
Implementation of FFT, DFT of Signals-Wavelet Transformation-Image Enhancement -Histogram Equalization-Smoothing-Sharpening-Compression-Segmentation-Morphology-Restoration-Edge Detection-Restoration.

(15)

TOTAL HOURS: **45**

TEXTBOOKS

1. Gérard Blanchet, Maurice Charbit, “Digital Signal and Image Processing Using MATLAB”, ISTE Ltd, 2006. (Para I-III)
2. John W. Wood, “Multidimensional Signal, Image, and Video Processing and Coding”, Second Edition, Academic Press. (Para IV).

REFERENCES

1. R.Ramanathan and K.P. Soman, “Digital Signal and Image Processing”, Elsevier Science, 2012.
2. Sandipan Dey, “Image Processing with Python”, BPB, 2021.

19MAME18 - CYBER SECURITY

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES

Consent of the Instructor

COURSE OUTCOMES

CO1 : Understand the theoretical concept of Cyber crime
CO2 : Enumerate the different legal responses to Cybercrime
CO3 : Understand and apply cyber forensics to detect threats and crimes.
CO4 : Analyze and evaluate the cyber security needs of an organization.
CO5 : Familiarize with case studies on cybercrimes and digital evidences

INTRODUCTION TO CYBER CRIME

Role of Electronic Communication Devices and Information and Communication Technologies in Cybercrime – Types of Cyber Crime – Classification of Cyber Criminals – Tools used in Cyber Crime – Factors influencing Cybercrime - Challenges to Cybercrime – Strategies to prevent Cybercrimes - Terms and Terminologies associated with Cybercrime.

(9)

CYBERCRIME - THE PRESENT AND THE FUTURE

Cryptocurrency – Bitcoin - Ethereum – Blockchain - Ransomware. **Cyber forensics:** Interrelations among Cybercrime, Cyber Forensics and Cyber Security - Cyber Forensics - Definition – Disk Forensics – Network Forensics – Wireless Forensics – Database Forensics – Malware Forensics – Mobile Forensics – Email Forensics.

(10)

TOOLS AND METHODS USED IN CYBERCRIME

Proxy Servers and Anonymizers - Phishing - Password Cracking - Keloggers and Spywares - DoS and DDoS attacks - SQL Injection - Buffer Overflow - Attacks on Wireless Networks.

(9)

ORGANIZATIONAL IMPLICATIONS

Web threats for Organizations - Security and Privacy implications from Cloud Computing - Social Media Marketing: Security Risks and Perils for Organizations - Social Computing and the Associated Challenges for Organizations – Protecting People's Privacy in the Organization-Forensics best practices for organizations.

(9)

DIGITAL EVIDENCE

Introduction to Digital Evidence and Evidence Collection Procedure - Sources of Evidence - Impediments to collection of Digital Evidence - Challenges with Digital Evidence.
Cybercrime: Real-Life Examples -Mini-Cases- Illustration of Financial Frauds in Cyber Domain - Digital Signature-related Crime Scenarios - Digital Forensics Case Illustrations-Online Scams.

(8)

TOTAL HOURS: 45

TEXTBOOKS

1. Dejey and S.Murugan, 'Cyber Forensics', Oxford University Press, 2018. (Para I, II, V)

2. Nina Godbole and Sunil Belapure, ‘Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives’, Wiley India. (Para III, IV, V)

REFERENCES

1. James Graham, Richard Howard and Ryan Otson, ‘Cyber Security Essentials’, CRC Press.
2. Mead, Nancy, R.Woody, Carol, ‘ Cyber Security Engineering : A Practical Approach for Systems and Software Assurance’, Pearson Education Asia, 2017.

19MAME19 - BUSINESS INTELLIGENCE

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES

Consent of the instructor

COURSE OUTCOMES

CO1: Apply Engineering approach to make better business decisions by analyzing risk factors.

CO2: Devise efficient managerial decisions based on mathematical models for real time business intelligence applications.

CO3: Develop strategic project planning by analyzing customer requirements in various dimensions with cost and time efficiency.

CO4: Differentiate various prototyping models and their applicability for data modeling based on real time requirements and infrastructure.

CO5: Specify ETL operations for real time business intelligence projects using tools and analyze the feasibility in terms of strengths and weaknesses.

BASICS OF BUSINESS INTELLIGENCE(BI)

Decision Support Systems: Definition - Representation of the decision-making process - Evolution of information systems - Development of DSS. Mathematical models for decision making: Structure - Development of a model - Classes of models.

(10)

BUSINESS INTELLIGENCE STAGES AND STEPS

BI definition - BI decision support initiatives - Development approaches - Engineering stages and the development steps - Parallel development tracks - BI project team structure.

Business Case Assessment: Justification - Drivers - Business Analysis issues - Risk assessment -Activities - Deliverables – Roles.

(9)

BI PROJECT PLANNING AND REQUIREMENTS

BI project: managing-Defining-Planning - Activities - Deliverables - Roles. Project Requirements Definition: General and specific requirements - Activities - Deliverables – Roles.

(8)

DATA ANALYSIS AND APPLICATION PROTOTYPING

Data Analysis: Business focused data analysis - Top-down logical data modeling -Bottom-up source data analysis - Data cleansing - Activities - Deliverables-Roles.

Prototyping: Purpose - Best practices - Types - Building successful prototypes - Application prototyping Activities - Deliverables - Roles.

(9)

DATABASE AND ETL DESIGN

Differences in database design - Logical and physical database design - Activities - Deliverables - Roles. ETL Design: Implementation strategies - Preparing for ETL process - Designing the extract programs, Transformation programs, Load programs, ETL process flow - Evaluating ETL tools - Activities - Deliverables- Roles.

(9)

TOTAL HOURS: 45

TEXTBOOKS

1. Carlo Vercellis, "Business Intelligence: Data mining and Optimization for Decision Making", John Wiley and Sons, 2009. (Para- I).

2. Larissa T.Moss and Shaku Atre, "Business Intelligence Roadmap: The Complete project life cycle for decision support applications", Addison Wesley, 2003. (Para II, III, IV & V).

REFERENCE

1. Efraim Turban, Ramesh Sharda, DursunDelen and Janine E. Aronson, "Business Intelligence – A Managerial Approach", Global Edition, Pearson, 2017

19MAMEL01 - SPATIAL DATA MODELLING AND ANALYSIS LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Acquire skills to carry out analysis on spatial data.
CO2: Create databases for spatial data and onscreen digitization.
CO3: Demonstrate the applications of raster and vector data.
CO4: Implement raster analysis and vector analysis.
CO5: Model the spatial variability

CONCEPTS
1. Rectification and Spatial Referencing of Digital Map
2. Onscreen Digitization and Database Creation
3. Projection and Re-projection of spatial data
4. Data Conversion – Vector to Raster, Raster to Vector
5. Populating Attribute data base and querying on attribute data
6. Generation of DEM: from contours, spot heights, GRID and TIN, Isometric mapping
7. Vector Analysis – Buffering, Overlay and Network analysis, flood mapping
8. Raster Analysis – Measurement - Arithmetic overlaying, Logical overlaying, Class interval selection, choropleth maps
9. Map Output - Bar charts, Pie charts and symbols
10. Map compilation
11. Modelling spatial variability
12. Weighted Theisson polygon and districting
13. Customization and scripting

Tools: Python,QGIS,Neighborvis

REFERENCE
1. Joel Lawhead, “Learning Geospatial Analysis with Python”, Second Edition, Packt Publications, 2015.

19MAMEL02 – AUGMENTED AND VIRTUAL REALITY LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
19MAME05

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Create and deploy a AR-VR application
CO2: Explore the physical principles of VR
CO3: Create a comfortable, high-performance VR application using Unity.
CO4: Identify, examine and develop software that reflects fundamental techniques for the design and deployment of VR experiences.
CO5: Develop real time applications using AR/VR techniques

CONCEPTS TO BE COVERED

1. Simple programs on Unity for VR development, and Image blending
2. Demonstration of the working of HTC Vive, Google Cardboard, Google Daydream and Samsung gear VR.
3. Develop a scene in Unity that includes: i. A cube, plane and sphere, apply transformations on the 3 game objects. ii. Add a video and audio source
4. Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the color, material and texture of each Game object separately in the scene.
5. Create an immersive environment (living room/ battlefield/ tennis court) with only static game objects. 3D game objects can be created using Blender or use available 3D models.
6. Include animation and interaction in the immersive environment created in 3D game objects.
7. Create a virtual environment for any use case. The application must include at least 4 scenes which can be changed dynamically including good UI, animation and interaction with game objects. (e.g. VR application to visit a zoo)

Suggested Software/Tool: Unity

REFERENCE
1. Jeff W Murray, Taylor & Francis, "Building Virtual Reality with Unity And Steamvr", 2nd Edition, 2020.

19MAMEL03 – NATURAL LANGUAGE PROCESSING LAB

Contact Hours

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

PRE-REQUISITES
19MAME07,19MAM65

COURSE OUTCOMES
CO1: Practice text and word representations in NLP
CO2: Use text segmentation, text summarization and categorization to process text data
CO3: Implement and evaluate different NLP applications using machine learning and deep learning methods
CO4: Design and develop chatbot applications and machine translations
CO5: Develop NLP based applications for various domains

CONCEPTS TO BE COVERED

- Representing and computing with Text data: Simple statistics
- Accessing text corpora and lexical resources
- Processing raw text from web: regular expressions for finding patterns, tokenizing text
- Text segmentation
- Categorizing and tagging words: N-Gram
- Text classification using supervised machine learning algorithms like Naïve Bayes, Deep Neural Networks etc.)
- Speech to text, Text to Speech
- Language modelling
- Analyzing meaning of sentence
- Building chatbots/Question answering
- Machine transaction, Text summarization
- Use of transformer models

Suggested Software: NLTK(Python)

REFERENCES

1. Denis Rothman “Transformers for Natural Language Processing”,Packt, 2021
2. Sowmya Vajjala , Bodhisattwa Majumder, Anuj Gupta “Practical Natural Language Processing”, BPO, 2020.

19MAMEL04- GRAPH ANALYTICS LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Implement Graph creation and detection
CO2: Implement machine learning techniques and algorithms in graph data
CO3: Use different node embedding methods for real time problems
CO4: Implement Graph Neural Networks and Implement Graph Convolution Network
CO5: Extracting data from social networks, financial transaction systems, and more and analyze it to derive patterns.

CONCEPTS TO BE COVERED

- Graph Creation and Analysis (Statistical) , Plotting graphs and Graph properties, Extracting features using graphs
- Node Embedding -Shallow Embedding and Random walk Embedding
- Implementation of graph algorithms-(Pathfinding & Graph Search, Centrality)
- Applications of Graph Neural Networks
- Graph Convolution Network (GCN) for graph-structured data
- Machine learning on graphs- Node Classification, Link Prediction, Clustering and Community Detection.
    - Social network analysis using Graphs (Yelp Social Network Data)
    - Text Analytics and NLP using graphs
    - Graph analysis for credit card transaction

Suggested Software: Python (Networkx), Neo4j, GraphX, Gephi

REFERENCE:

1. Aldo Marzullo, Claudio Stamile, and Enrico Deusebio, Graph Machine Learning, Packt Publishing, 2021.
2. Mark Needham, Amy E. Hodler, Graph Algorithms: Practical Examples in Apache Spark and Neo4j, O'Reilly, 2019

19MAMEL05 - INTERNET OF THINGS LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Choose the required sensor and perform input output operations for a given requirement.
CO2: Devise interface circuit for connecting a chosen sensor to Arduino board.
CO3: Develop software for Arduino board to interact with the sensor to meet requirements.
CO4: Develop software to interact (send/receive data) with Web/Application server located in the Internet.
CO5: Use data analytics tool to analyse the data collected and present the report to the end user.

CONCEPTS TO BE COVERED
1. Familiarize with Arduino/Raspberry Pi
2. To interface LED/Buzzer and turn on/off LED
3. To interface with digital sensor like IR/LDR and push button to on/off the LED
4. To interface with DTH11 sensor and read and print temperature and humidity readings.
5. To interface Bluetooth and send sensor data to smartphone using Bluetooth.
6. Program to interact with Thingspeak Cloud
7. Program to interact with MQTT broker
8. Perform analytics on sensor data and visualize the results in mobile UI
9. Develop end-to-end intelligent IoT applications

REFERENCE
1. Pooja Baraskar, “Practical Internet of Things for Beginners: IOT Projects with Realsense, Azure, Arduino and Intel Edition”, Apress, 2020

19MAMEL06 - CYBER SECURITY LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

CO1 : Perform Encryption and Decryption techniques
CO2 : Implement detection and prevention process
CO3 : Perform detection method against various attack mechanism
CO4 : Understand the implementation of various techniques and security algorithms
CO5 : Apply different tools used for secure data transmission and for creating digital signature.

TOPICS TO BE COVERED

1. Perform Encryption and Decryption using Substitution techniques
   a) Caesar Cipher b) Playfair Cipher c) Hill Cipher
2. Perform Encryption and Decryption using Transposition techniques
   a) Rail Fence row & Column Transformation
3. Implement Diffie-Hellman Key Exchange mechanism
4. Implement the following attacks
   a) Dictionary Attack b) Brute- Force attack
5. Calculate the message digest of a text using the SHA-1 algorithm
6. Detect ARP Spoof Attack using Scapy in Python
7. Demonstrate Intrusion Detection System using any tool
8. Implement for providing secure storage and secure data transmission
9. Implement RSA Digital Signature Scheme
10. Defeating Malware - Building Trojans, Rootkit Hunter

ONE CREDIT COURSES

19MAMOC01- ECONOMETRICS AND MACHINE LEARNING IN FINANCE

Contact Hours

L	T	P	C
1	0	0	1

PRE-REQUISITES

Consent of the Instructor

COURSE OUTCOMES

CO1: Understand the fundamentals of econometrics and financial markets.

CO2: Select and implement linear regression, logistic regression and random forest models as per business requirement.

CO3: Understand the techniques of fine tuning the model parameters to improve its performance.

CO4: Apply machine learning models to financial data and derive insights.

ECONOMETRICS

Review of Probability and Statistics-Fundamentals of Economics

Financial Institutions, Products and Markets-Introduction to Financial Institutions-Introduction to Financial Products and Markets

(5)

MACHINE LEARNING IN FINANCE

Review of R programming language-Review of machine learning

Building a multiple linear regression model

Building a logistic regression model

Validating Regression Models – Performance Diagnostics

Building a regression model to forecast losses for a trading desk

Building a logistic regression model to assess the credit quality of the borrower

Building a model using KNN, K-means and Naive Bayes classifier and understanding the testing the performance of the models

Building Prudential Life Insurance Assessment using Multinomial Logit and Random Forest.

Discussing resources for having a career in model development, validation, quantitative research and data science.

(10)

TOTAL HOURS: **15**

19MAMOC02 – JAVA PROGRAMMING

Contact Hours

L	T	P	C
0	0	2	1

ASESSMENT: PRACTICALS

COURSE OUTCOMES

CO1: Able to learn and implement classes and objects in Java.
CO2: Able to apply inheritance and create interfaces for the given requirement.
CO3: Able to handle the different kinds of exceptions arising in a Java program.
CO4: Able to use IO streams for reading and writing data in Java.
CO5: Able to write socket programs in Java to create network applications.

INTRODUCTION TO OBJECT ORIENTED PROGRAMMING

Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance – Polymorphism.
OOP in Java –Characteristics of Java – The Java Environment - Java Source File -Structure – Compilation- Fundamental Programming Structures in Java –Objects and Classes - Strings

(6)

INHERITANCE AND INTERFACES

Inheritance – Using Super - Creating a Multilevel Hierarchy – Constructors – Method Overriding – Using Abstract Classes – Using Final with Inheritance – The Object Class
Packages and Interfaces – Packages – Access Protection – Importing Packages - Interfaces

(10)

EXCEPTION HANDLING AND I/O

Exceptions – Exception Hierarchy - Throwing and Catching Exceptions – Built-in exceptions - Creating own exceptions. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files

(8)

SOCKET PROGRAMMING

Basic Concepts- Protocols and Terminology-Starting Network Programming in Java-Multithreading and Multiplexing. **Database Connectivity:** JDBC

(6)

Programming exercises based on the above concepts

TOTAL HOURS: 30

REFERENCES

1. Herbert Schildt, “Java The complete reference”, 11th Edition, McGraw Hill Education, 2020