M.D UNIVERSITY
SCHEME OF STUDIES AND EXAMINATION
M.TECH 1st YEAR (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)
SEMESTER 2nd
Modified/Revised CBCS Scheme effective from 2026-27

Sr. No	CourseNo.	Subject	TeachingSchedule				Examination Schedule (Marks)				Duration ofExam(Hours)	No ofhours /week
				T	P	TotalCredits	Marksof Class works	Theory	Practical	Total		
1	22AIML22C1	Applied Machine Learning		0	-	4	50	100	-	150	3	4
2	16CSE22C2 [Common with M.Tech(CSE)]	Algorithm Design		0	-	4	50	100	-	150	3	4
3	22AIML22C3	Seminar			2	2	50	-	-	50	-	2
4	22AIML22CL1	Applied Machine Learning Lab		-	2	2	50	-	50	100	3	2
5	**24CSE22CL2 [Common with M.Tech(CSE)]**	**Algorithm Design Lab**		-	2	2	50	-	50	100	3	2
6	16MCSE22D1 16MCSE22D2 22AIML22D1 22AIML22D2 26MCSE22D5	**Elective-1**		0	-	4	50	100	-	150	3	4
7		Open Elective				3						3
8		Foundation Elective				2						2
					6	23	300	300	100	650	15	23

NOTE: Examiner will set nine question in total. Question One will be compulsory and will comprises of allsection and remaining eight questions to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Elective 1- Choose any one from the following papers

16MCSE22D1	Mobile and Wireless Communication [Common with M.Tech CSE)]
16MCSE22D2	Optimization Techniques [Common with M.Tech (CSE)]
22AIML22D1	Natural Language Processing and Speech Recognition
22AIML22D2	Human-Computer Interaction
26MCSE22D5	Quantum Computing

Open Elective

A candidate has to select this paper from the pool of Open Electives provided by the University

Foundation Elective

A candidate has to select this paper from the pool of Foundation Electives provided by the University.

22AIML21C1 : Artificial Intelligence

Marks			**Credits**
LT P	**Exam:**	100	4
4 - -	**Sessional:**	50	
Total:		150	4

Durationof Exam:3hrs.

NOTE: Examiner will set nine questions in total. Question One will be compulsory and willcomprise all sectionsand the remaining eight questions to be set by taking two questions fromeach unit. The students have to attempt five questions in total,first being compulsory andselectingonefrom eachUnit.

Unit-1

Fundamentals of Artificial Intelligence:

Definition of AI, History of AI, Turing Test, Chinese Room argument nature of AI problems, examples of AI problems. AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem-solving agents, AI problem formulation.

Unit-2

Problem Solving by Search:

Uninformed Search: Depth First Search (DFS), Breadth First Search (BFS), Iterative Deepening, Bidirectional Search. Informed Search: Best First Search, Greedy Best First Search, and A*. Local Search: Hill Climbing. Problem Reduction Search: AO*. Adversarial Search: Min Max Algorithm, Alpha-Beta Pruning. Population-Based Search: Ant Colony Optimization, Genetic Algorithm.

Unit-3

Knowledge Representation:

Types of Knowledge, Knowledge Representation Techniques/schemes: Propositional Logic, Predicate Logic, Semantic nets, Frames, Production Rules. Knowledge representation issues.

Reasoning with Uncertainty: Representing Uncertain Knowledge, Reasoning with Uncertain Knowledge, Probabilistic Reasoning: Bayesian Reasoning, Bayesian Networks.

Unit- 4

Planning:

Introduction to Planning, Representation of Planning, Partial-order Planning.

Introduction to Neural Networks, Expert System, Current trends in Artificial Intelligence.

Suggested readings:

1. Stuart Russell & Peter Norvig : "Artificial Intelligence : A Modern Approach", Pearson Education, 2nd Edition

2. Elaine Rich and Kevin Knight: "Artificial Intelligence." Tata McGraw Hill

3. Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI.,2010.

4. Artificial intelligence, Patrick Henry Winston, 1992, Addition Wesley 3 Ed.

22AIML21C2: Python Programming

		Marks	Credits
LTP	**Exam:**	100	4
4 --	**Sessional:**	50	
	Total:	150	4
DurationofExam:	3hrs.		

NOTE: Examiner will set nine question in total. Question One will be compulsory and willcomprises of all section and remaining eight questions to be set by taking two questionsfrom each unit. The students have to attempt five questions in total, first being compulsoryand selecting onefromeachUnit.

UNIT-1
Introduction to Python:
History and Origin of Python Language, Features, Python, Twomodes of using Python interpreter, variable and data types, operator and their precedence,Python string & slicing, Python lists, mutable and immutable types, Input from keyboard.. Loops and Iterations, Functions, Strings & Lists.

UNIT-2
Modules and Packages: Python Modules and Packages, Different ways to import Packages,File Input/output,The pickle module, Formatted Printing, Exception Handling.
Arrays and Matrices: The NumPy Module, Creating Arrays and Matrices, Copying,

UNIT-3
Introduction to Pandas : History of pandas, Advantages, Getting started with pandas, Data structures for manipulating data, Selecting data from pandas data frame, Slicing and dicing using pandas, Strings with pandas, Cleaning up messy data with pandas, Selecting entries and dropping entries.

UNIT-4
Files and Streams: File modes and permissions, Reading & Writing datafrom a file, Redirecting output streams to files, Working with directories, CSV files and DataFiles.
Python and Graphics: Simple graphics, Turtle operations, Manipulating turtle screen, Drawing two dimensional shapes, examining an object attributes, Taking a random walk, Color and RGB scheme

Suggested readings:
1. Fluent Python: Clear, Concise, and Effective Programming, by Luciano Ramalho
2. Learn Python 3 The Hard Way, by Zed A. Shaw
3. Head First Python: A Brain-Friendly Guide, by Paul Barry
4. Python Tricks by Dan Bader
5. Automating Boring Stuff with Python

22AIML21C3 : Data Mining and Big Data Analytics

		Marks	Credits
LTP	**Exam:**	100	4
4 --	**Sessional:**	50	
	Total:	150	4
Duration of Exam:	3hrs.		

NOTE: Examiner will set nine question in total. Question One will be compulsory and willcomprises of all section and remaining eight questions to be set by taking two questionsfrom each unit. The students have to attempt five questions in total, first being compulsoryand selecting onefromeachUnit.

UNIT-1

Data Mining Concepts: Introduction to Data Mining Systems, Knowledge Discovery Process, Data Mining Techniques, Issues, Applications, Data Objects and Attribute types, Statistical description of data; Data Pre-processing – Cleaning, Integration, Reduction, Transformation and Discretization; Data Visualization, Data similarity and dissimilarity measures.

UNIT-2

Classification and Clustering: Decision Tree Induction, Bayesian Classification, Rule Based Classification, Support Vector Machines, Model Evaluation and Selection, Techniques to improve Classification Accuracy. Clustering Techniques: Cluster analysis, Partitioning Methods - Hierarchical Methods, Density Based Methods, Grid Based Methods; Evaluation of clustering, Clustering high dimensional data.

UNIT-3

Overview of Big Data and Hadoop: Types of Digital Data, Overview of Big Data, Challenges of Big Data,Modern Data Analytic Tools, Big Data Analytics and Applications;Overview and History of Hadoop, Apache Hadoop, Analysing Data with Hadoop,

HDFS: Concepts of Hadoop Data File System, Design of HDFS, Command Line Interface, Hadoop file system interfaces, Data flow; Hadoop I/O: Compression and Serialization.

UNIT - 4

Map Reduce: Introduction, Map Reduce Features, How Map Reduce Works, Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats.

Hadoop Eco System: Pig - Introduction to PIG, Execution Modes of Pig, Hive: Hive Shell, Hive Services, Big SQL: Introduction.

Introduction of R and Big R, Collaborative Filtering, Big Data Analytics with Big R.

Suggested Readings:

1. Jiawei Han & Micheline Kamber: Data Mining - Concepts & Techniques, Harcourt India PVT Ltd. (Morgan Kaufmann Publishers).
2. I.H. Whiffen: Data Mining, Practical Machine Learning tools & techniques with Java (Morgan Kanffmen)
3. A.K. Pujari: Data Mining Techniques, University Press.
4. Pieter AdriaansDolfZantinge: Data Mining, Addition Wesley.
5. David Hand, HeikkiMannila, and Padhraic Smyth: Principles of Data Mining, PHI Publication.
6. Michael Berthold, David J. Hand: Intelligent Data Analysis, Springer.
7. Tom White: Hadoop- The Definitive Guide, Third Edition, O'reilly Media.
8. Seema Acharya, SubhasiniChellappan: Big Data Analytics, Wiley.
9. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos: Understanding BigData: Analytics for Enterprise Class Hadoop and Streaming Data, Mc Graw Hill publishing.
10. Anand Rajaraman and Jeffrey David Ullman: Mining of Massive Datasets, Cambridge University Press.
11. Glenn J. Myatt: Making Sense of Data, John Wiley & Sons.
12. Zikopoulos, Paul, Chris Eaton: Understanding Big Data- Analytics for Enterprise Class Hadoop and Streaming Data, Tata McGraw Hill Publications.

16CSE22C1 Soft Computing

		Marks	Credits
LTP	**Exam:**	100	4
4 --	**Sessional:**	50	
	Total:	150	4
Duration of Exam: 3 hrs			

NOTE: Examiner will set nine question in total. Question One will be compulsory and willcomprises of all section and remaining eight questions to be set by taking two questionsfrom each unit. The students have to attempt five questions in total, first being compulsoryand selecting onefromeachUnit.

UNIT 1

Neural Networks : History, Overview of Biological Neuro-System, Mathematical Models of Neurons, ANN architecture, Learning rules, Gradient Descent Algorithm, Learning Paradigms-Supervised, Unsupervised and Reinforcement Learning, ANN Training Algorithms-Perceptrons, Training Rules, Delta, Back Propagation Algorithm, Multilayer Perceptron Model, Hopfield Networks, Associative Memories, Applications of Artificial Neural Networks.

UNIT 2

Fuzzy Logic: Introduction to fuzzy Logic, Classical and Fuzzy Sets, Overview of Classical Sets, Membership Function, Fuzzy Rule generation. Operations on Fuzzy Sets: Compliment, Intersection, Union, Combination of Operations, Aggregation Operation.

UNIT 3

Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations. Classical Logic, Multi-Valued Logics, Fuzzy Propositions, Fuzzy Qualifiers, Linguistic Hedges.

UNIT 4

Uncertainty Based Information: Information & Uncertainty, Nonspecificity of Fuzzy & Crisp Sets, Fuzziness of Fuzzy Sets.

Suggested readings:

1. Neural Networks Simon Haykin
2. Neural Networks-Kosko.
3. Principles of Soft Computing -Dr. S. N. Sivanandam and Dr. S. N. Deepa,
4. Fuzzy Logic & Fuzzy Sets Klir& Yuan
5. Neutral Networks-Satish Kumar

16CSE21C5: Mathematical Foundation of Computer Science

		Marks	Credits
LTP	**Exam:**	100	4
4 --	**Sessional:**	50	
	Total:	150	4
Duration of Exam: 3 hrs	3hrs.		

Course Outcomes:

Upon completing the course, the student will:

CO1 Be familiar with the basics concepts in theory of computation;

CO2 Be able to construct finite state machines and the equivalent regular expressions.

CO3 Be able to construct pushdown automata and their equivalent context free grammars.

CO4 Be exposed to the advanced concepts of theory of automata computation.

NOTE: Examiner will set nine question in total. Question One will be compulsory and will comprises of all section and remaining eight questions to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT 1

Regular Languages: Finite automata, DFA, NFA, Equivalence of DFA & NFA. An application, Mealy and Moore Models, Regular expressions and languages.Context free languages: CFGs, Applications, Ambiguity removal, CNF,GNF.

UNIT 2

PushDown Automata: Basics of PDA, Acceptance By PDA, PDA and CFL, Parsing and PDA: Top Down Parsing and Bottom up Parsing

UNIT 3

Turing Machine: Turing machines, variants of TMs ,Restricted TMs, TMs and Computers.
Decidability: Decidable languages, decidable problems concerning Context free languages, the halting problem, halting problem is undecidable.

UNIT 4

Reducibility and Computability: Undecidable problems from language theory–Regular expressions, Turing machines, Reduction. A simple undecidable problem (PCP), Primitive recursive functions, tractable decision problems, theory of Optimization, Church- Turing Thesis.

References:

1. Introduction to Theory of Computation –Michael Sipser(Thomson Nrools /Cole)
2. Introduction toAutomataTheory,LanguagesandComputations–J.E.Hopcroft,RajeevMotwani&J.D.Ullman (PearsonEducationAsia),2nd Edition.
3. TheoryofComputationbyPeterLinz
4. Introductiontolanguagesandtheoryofcomputation–JohnC.Martin(MGH)

22AIML21C6 Seminar

LTP		Marks	Credits
- -- 2	**Sessional:**	50	**2**
	Total :	50	2

A candidate has to present a seminar on a recent topic/ technology/ research advancementand has to submit a seminar report. The marks will be given on the basis of seminar report,contentsofthepresentation,communication andpresentation skills.

22AIML21CL1: Artificial Intelligence Lab

Marks	**Credits**			
LTP	**Exam**	**:**	50	2
- -2	**Sessional**	**:**	50	
Total		**:**100	2	

A student has to perform10-12 practical based on theory paper.

List of Program:

1. Write a Program to Implement Breadth First Search using Python.
2. Write a Program to Implement Depth First Search using Python.
3. Write a Program to Implement Tic-Tac-Toe game using Python.
4. Write a Program to Implement 8-Puzzle problem using Python.
5. Write a Program to Implement Water-Jug problem using Python.
6. Write a Program to Implement Travelling Salesman Problem using Python.
7. Write a Program to Implement Tower of Hanoi using Python.
8. Write a Program to Implement Monkey Banana Problem using Python.
9. Write a Program to Implement Missionaries-Cannibals Problems using Python.
10. Write a Program to Implement 8-Queens Problem using Python.

22AIML21CL2 Python Programming Lab

			Marks	Credits
LTP	**Exam**	**:**	50	2
2	**Sessional**	**:**	50	
	Total	**:**	100	2

Astudenthastoperform10-12 practical basedon theorypaper.

List of Programs
1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (power of a number)
5. Find the maximum of a list of numbers
6. Linear search and Binary search
7. Selection sort, Insertion sort
8. Merge sort
9. First n prime numbers
10. Multiply matrices
11. Programs that take command line arguments (word count)
12. Find the most frequent words in a text read from a file
13. Simulate elliptical orbits in Pygame
14. Simulate bouncing ball using Pygame

22AIML22C1 Applied Machine Learning

UNIT 1:

Introduction

Machine Learning: Definition, History, Need, Features, Block diagrammatic representation of learning machines, Classification of Machine Learning: Supervised learning, Unsupervised learning, Reinforcement Learning, Machine Learning life cycle, Applications of Machine Learning.

UNIT 2:

Dimensionality Reduction

Dimensionality reduction: Definition, Row vector and Column vector, how to represent a dataset, how to represent a dataset as a Matrix, Data preprocessing in Machine Learning: Feature Normalization, Mean of a data matrix, Column Standardization, Co-variance of a Data Matrix, Principal Component Analysis for Dimensionality reduction.

UNIT 3:

Supervised Learning

Supervised Learning: Definition, how it works. Types of Supervised learning algorithms: k-Nearest Neighbours, Decision Trees, Naive Bayes, Linear Regression, Logistic Regression, and Support Vector Machines.

UNIT 4:

Unsupervised Learning: Clustering: K-means. Ensemble Methods: Boosting, Bagging, Random Forests.

Evaluation: Performance measurement of models in terms of accuracy, confusion matrix, precision & recall, F1-score, receiver Operating Characteristic Curve (ROC) curve and AUC,

Median absolute deviation (MAD), Distribution of errors

Suggested books

1. E. Alpaydin, Introduction to Machine Learning, Prentice Hall of India, 2006.

2. T Hastie, R Tibshirani and J Friedman, The Elements of Statistical Learning Data Mining, Inference, and Prediction, 2nd Edition, Springer, 2009.

3. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2010.

Suggested reference books

1. R. O. Duda, P. E. Hart, and D.G. Stork, Pattern Classification, John Wiley and Sons, 2012.

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

16CSE22C2	**Algorithm Design**		
		Marks	**Credits**
LTP	**Exam:**	100	4
4- -	**Sessional:**	50	
	Total:	150	4
DurationofExam:	3hrs.		

Course Outcomes:

Students who complete the course will have demonstrated the ability to do the following:

CO1 Argue the correctness of algorithms using inductive proofs and invariants.
CO2 Analyze worst-case running times of algorithms using asymptotic analysis.
CO3 Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it.
CO4 Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it.
CO5 Explain the major graph algorithms and their analyses. Employ graphs to model engineering problems

NOTE: Examiner will set nine question in total. Question One will be compulsory and will comprises of all section and remaining eight questions to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT 1

Foundation & Data Structure:

Foundation & Elementary Data Structure: Algorithms,Performance analysis: Space & time complexity, Growth of functions, Divide & Conquer, Recurrence Equations, Basic elementsof data structure like Stacks & Queues, Trees, Graphs, Linked List, Sorting & Order statistics.
DataStructure:Dynamicsets&searching:Introduction,Arraydoubling,Amortizedtime analysis, R-B trees, Hashing, Dynamic equivalence relations & Union-Find programs, Priority queues with a decrease key operation.
Graph&graphtraversals:DFS,stronglyconnectedcomponents,Bi-connected components.

UNIT 2

Advanced Design &Analysis Techniques:

Greedy & Dynamic Method: General methods, Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees, Optimal merge patters, Single-source shortest path, 0/1 Knapsack, Multistage graphs, All-pair shortest path, Optimal binary search trees, Travelling salesperson problem, Flow shop scheduling.
Backtracking & Branch and Bound: General methods, 8 Queens problem, Sum of subsets, Graph coloring, Hamiltonian cycles, Knapsack problem, Travelling salesperson problem, Efficiency consideration.

UNIT 3

NP-Hard&NP-CompleteProblems:Basicconcepts,Cook'sTheorem,NP-hardgraph problem, NP-Hard scheduling problems.
StringMatching:Introduction,Astraightforwardsolution,TheKnuth-Morris-Pratt algorithm, The Boyer-Moore algorithm, approximate string matching.

UNIT 4

Parallel Algorithms: Introduction, Parallelism, The PRAM, and other models, some simple PRAM algorithms, Handling write conflicts, Merge and Sorting, Finding connected components.

Approximation algorithms: Introduction, Absolute approximations, ϵ- approximations, Polynomial time approximation schemes, Fully Polynomial time approximations schemes.

References:

1. Computer Algorithms: Introduction to design and analysis (3rd edition) by Sara Baase and Allen Van Gelder , Pearson, 2000.
2. FundamentalsofAlgorithmsbyGillesBrassardandPaulBratley
3. DesignandAnalysisofAlgorithms(ComputerscienceSeries)byJeffreyD.SmithPubl.
4. FundamentalsofComputeralgorithms,EllisHorowitzandSratajSahnim1978, Galgotia publ.
5. AlgorithmsDesign(PIE)byEvaTardosandJonKlienberg,person.

IntroductiontoAlgorithms,ThomashCormen,HarlesE leisersonand RonaldLrivest: 1990, TMH.

22AIML22C3 : Seminar

LTP		Marks	Credits
- --	**Sessional:**	50	**2**
2 2	**Total** :	50	2

A candidate has to present a seminar on a recent topic/ technology/ research advancementand has to submit a seminar report. The marks will be given on the basis of seminar report,contentsofthepresentation,communication andpresentation skills.

22AIML22C1 Applied Machine Learning Lab

LTP		Marks	Credits
- - 2	**Sessional:**	50	**2**
	Total :	50	2

List of Experiments:

A student has to attempt 10-12 practicals based on theory on an open-source tool.

22AIML22CL1 Algorithm Design LAB

MarksCredits					
LTP		**Exam**	**:**	50	2
-	**-2**	**Sessional**	**:**50		
Total			**:**100		2

Course Outcomes:

Upon completion of this course, students will be able to do the following:

CO 1	Analyze the asymptotic performance of algorithms.
CO 2	Write rigorous correctness proofs for algorithms.
	Demonstrate a familiarity with major algorithms and data structures.
CO 3	Apply important algorithmic design paradigms and methods of analysis.
	Synthesize efficient algorithms in common engineering design situations
CO 4	
CO 5	

A student has to perform 10-12 practicals based on theory paper.

Suggested list of experiments:

1. Write a program to search an element in a two –dimensional array using linear search.

2. Using iteration & recursion concepts write programs for finding the element in the array using Binary Search Method

3. Write a program to perform following operations on tables using functions only

a) Addition b) Subtraction c) Multiplication d) Transpose

4. Using iteration & recursion concepts write the programs for Quick Sort Technique

5. Write a program to implement the various operations on string such as length of string concatenation, reverse of a string & copy of a string to another.

6. Write a program for swapping of two numbers using call by value and call by reference strategies.

7. Write a program to implement binary search tree.(Insertion and Deletion in Binary search Tree)

8. Write a program to create a linked list & perform operations such as insert, delete, update, reverse in the link list

9 .Write the program for implementation of a file and performing operations such as insert, delete, update a record in the file.

10. Create a linked list and perform the following operations on it a) add a node

b) Delete a node

11. Write a program to simulate the various searching & sorting algorithms and compare their timings for a list of 1000 elements.

12. Write a program to simulate the various graph traversing algorithms.

13. Write a program which simulates the various tree traversal algorithms.

16CSE22D1 MOBILEANDWIRELESS COMMUNICATION

Marks			Credits
LTP	**Exam:**	100	4
4- -	**Sessional:**	50	
Total:		150	4

Durationof Exam:3hrs.

NOTE: Examiner will set nine question in total. Question One will be compulsory and will comprises of all section and remaining eight questions to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT 1

Application, history, market, reference model and overview. Wireless Transmission- Frequencies, signals, antennae, signal propagation, multiplexing, modulation, spread spectrum, cellular system.

MAC and Telecommunication System: Specialized MAC, SDMA, FDMA , TDMA – FixedTDM, classical ALOHA, Slotted, ALOHA, CSMA ,DAMA, PKMA, reservation TDMA. Collision avoidance, polling inhibit sense multiple access. CDMA, comparison, CSM-mobile services, architecture radio, interface, protocol, localization, calling handover, security, new data services, Introduction to W'LL.

UNIT 2

Satellite and Broadcast Systems: History, Applications, GEO, LEO, MEO, routing,localization, handover in satellite system. Digital audio and video broadcasting. **WIRELESS LAN:** IEEE 802 11- System and protocol architecture, physical layer. MAC layered management. Bluetooth- User scenarios, physical layer, MAC Layer, networking, securityand link management.

UNIT 3

Mobile Network Layer: Mobile IP-goals, assumptions, requirement, entities, terminology, IP packet delivery. Agent advertisement and discovery, registration, tunneling, encapsulation, optimization, reserve tunneling, IPv6.DHCP.Adhoc Networks, Routing, destination sequence distancevector,dynamicsourcerouting,hierarchicalalgorithm,algorithm,algorithmmetric.

UNIT 4

Mobile Transport Layer: Traditional TCP, Indirect TCP, Snooping; TCP, Mobile TCP fast retransmission, Transaction oriented TCP. **Support for Mobility:** File, system, WWW-HIT, HTML, system architecture. WAP-architecture, Wireless datagram, protocol, wireless transport layer security, wireless transaction protocol, application environment, telephony application.

References:

1. JochenSchiller,"MobileCommunication",PearsonEducation,2002
2. LEE,"MobileCellularTelecommunications"McGRAW-Hill,2nd Edition.
3. WirelessCommunications:TheodoreSRappaport;Pearsons

16CSE22D2	OPTIMIZATIONTECHNIQUES		
		Marks	**Credits**
LTP	**Exam:**	100	4
4- -	**Sessional:**	50	
Total:		150	4

Durationof Exam:3hrs.

NOTE: Examiner will set nine questions in total. Question One will be compulsory and will comprises of all section and remaining eight questions to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT 1

Linear Programming: Simplex Method, Big M-Method, Duality in Linear Programming, Sensitivity Analysis, Revised Simplex Method, Two-Phase Simplex Method, Dual Simplex Method. Integer Linear Programming: Branch and Bound Algorithms, Gomory Cutting Plane Method.

UNIT 2

Transportation Problems: Types of Transportation Problems, Mathematical Models, Transportation Algorithms. **Assignments:** Definition, Differences between Transportation and Assignment Models, Representation Assignment Problem as Transportation Problem and as Linear Programming, Assignment Algorithm -Hungarian Method

UNIT 3

Non-Linear Programming: Classical optimization Techniques, NLP with constraints:Graphical Solution, Multivariable Optimization with Equality constraints (Lagrange Multipliers Method), with inequality constraints-Kuhn-Tucker conditions, Quadratic Programming and Separable Programming: Standard form, Wolf's Method, Beale's Method
.SearchMethodforUnconstrainedNon-LinearProgrammingProblems.

UNIT 4

Reliability: Basic concepts, conditional failure rate function, Failure time distributions, certain life Models,Reliabilityof asystemin termsof thereliabilityof itscomponents,series system, parallel system. Queuing Theory: Introduction, elementsor Parameters of Queuing system, Steady state Balance Equation, Kendall's Notation for Representing QueuingModels,Model!:SingleserverModel(M/M/1/∞/∞/FCFS),Model2:M/M/1/□/N/FCFS)Finite Capacity Queue System,Model3:Multi-server Model, Model4: Machine Servicing Model.

References:

1. OptimizationTechniquesbyC.MohanandKusumDeep,NewAge International
2. OperationsResearchbyK.Rajagopal,PHI,Inida.
3. ReliabilityEngineeringbyKKAggarwal,Springer.

22AIML22D1 NATURAL LANGUAGE PROCESSING & SPEECH RECOGNITION

Marks credits

L	T	P		Exam :	100	4
4	-	-		Sessional :	50	
Total :		150	4			

Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 8 parts (short-answer type questions) covering the entire syllabus and will carry 20 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 20 marks. Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting one quest ion from each Unit.

UNIT – I

Introduction to Natural Language Processing: NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity.

Regular Expressions: Regular Expressions, Automata, Similarity Computation: Regular Expressions, patterns, FA, Formal Language, NFSA, Regular Language and FSAs, Raw Text Extraction and Tokenization, Extracting Terms from Tokens, Vector Space Representation and Normalization, Similarity Computation in Text.

Morphology and Finite-State Transducers: Inflection, Derivational Morphology, FiniteState Morphological Parsing, The Lexicon and Morphotactics, Morphological Parsing with Finite State Transducers, Combining FST Lexicon and Rules, Lexicon-free FSTs: The Porter Stemmer, Human Morphological Processing.

UNIT - II

Matrix Factorization and Topic Modeling: Introduction, Singular Value Decomposition, Nonnegative Matrix Factorization, Probabilistic Latent Semantic Analysis, Latent Dirichlet Allocation Computational

Phonology and Text-to-Speech: Speech Sounds and Phonetic Transcription, The Phoneme and Phonological Rules, Phonological Rules and Transducers, Advanced Issues in Computational Phonology, Machine Learning of Phonological Rules, Mapping Text to Phones for TTS, Prosody in TTS .

ProbabilisticModels of Pronunciation and Spelling: Dealing with Spelling Errors, Spelling Error Patterns, Detecting NonWord Errors, Probabilistic Models, Applying the Bayesian method to spelling, Minimum Edit Distance, English Pronunciation Variation, The Bayesian method, Pronunciation in Humans.

N-gram Language Models: The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. Smoothing, Backoff, Deleted Interpolation, N-grams for Spelling and Pronunciation, Entropy.

UNIT - III

HMMs and Speech Recognition: Speech Recognition Architecture, Overview of Hidden Markov Models, The Viterbi Algorithm Revisited, Advanced Methods for Decoding, Acoustic Processing of Speech, Computing Acoustic Probabilities, Training a Speech Recognizer, Waveform Generation for Speech Synthesis, Human Speech Recognition. Word Classes and Part-of-Speech Tagging: Tagsets for English, Part of Speech Tagging, Rule-based Part-of-speech Tagging, Stochastic Part-of-speech Tagging, Transformation Based Taggin.

Context-Free Grammars for English: Context-Free Rules and Trees, Sentence-Level Constructions, The Noun Phrase, Coordination, Agreement and The Verb Phrase and Sub- categorization, Auxiliaries, Spoken Language Syntax, Grammar Equivalence & Normal Form, Finite State & Context-Free Grammars, Grammars & Human Processing.

UNIT - IV

Parsing with Context-Free Grammars and Features and Unification: Parsing as Search, A Basic Top-down Parser, The Earley Algorithm, Finite-State Parsing Methods, Feature Structures, Unification of Feature Structures, Features Structures in the Grammar, Implementing Unification, Parsing with Unification Constraints, Types and Inheritance

Lexicalized and Probabilistic Parsing: Probabilistic Context-Free Grammars, Problems with PCFGs, Probabilistic Lexicalized CFGs, Dependency Grammars, Human Parsing, The Chomsky Hierarchy, How to tell if a language isn't regular, Natural Language Context-Free or not, Complexity and Human Processing.

Representing Meaning and Semantic Analysis: Computational Desiderata for Representations, Meaning Structure of Language, First Order Predicate Calculus, Some Linguistically Relevant Concepts, Alternative Approaches to Meaning, Syntax-Driven Semantic Analysis, Attachments for a Fragment of English, Integrating Semantic Analysis into the Earley Parser, Idioms and Compositionality, Robust Semantic Analysis

Text Sequence Modeling and Deep Learning: Statistical Language Models, Kernel Methods, Word-Context Matrix

Factorization Models, Neural Language Models, Recurrent Neural Networks.

Suggested Readings:

1. Daniel Jurafsky and James H.Martin: Speech and Language Processing(2nd Edition),Prentice Hall:2 edition,2008.
2. CharuC.Aggarwal: Machine Learning for Text Springer,2018 edition
3. Christopher D.Manning and Hinrich Schuetze: Foundations of Statistical Natural Language Processing MIT press.
4. Steven Bird,Ewan Klein and Edward Loper: Natural Language Processing with Python,O'Reilly Media.
5. Roland R.Hausser: Foundations of Computational Linguistics:HumanComputer Communication in Natural Language,Paperback,MIT press..
6. Any other book(s) covering the contents of the paper in more depth.

Note: Latest and additional good books may be suggested and added from time to time

22AIML22D2 HUMAN COMPUTER INTERACTION

Marks	credits			
L T P		Exam :	100	4
4 - -		Sessional :	50	
Total :	150	4		

Note:
Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 8 parts (short-answer type questions) covering the entire syllabus and will carry 20 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 20 marks. Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting one quest ion from each Unit.

UNIT I

Introduction: The Human, The Computer, The interaction, Paradigms, Usability of Interactive Systems, Guidelines, Principles and Theories.
Design Process: Interaction design basics, HCI in the software process, Design rules, Implementation support, Evaluation techniques, Universal design, User Support.

UNIT II

Models and Theories: Cognitive models, Socio-organizational issues and stakeholder requirements, Communication and collaboration models, Task analysis, Dialogue notations and design, Models of the system, Modelling rich interaction.

UNIT III

Interaction Styles: Direct Manipulation and Virtual Environments, Menu Selection, Form Filling and Dialog Boxes, Command and Natural Languages, Interaction Devices, Collaboration and Social Media Participation.

UNIT IV

Design Issues: Quality of Service, Balancing Function and Fashion, User Documentation and Online Help, Information Search, Information Visualization.
Outside the Box: Group ware, Ubiquitous computing and augmented realities, Hypertext, Multimedia and the World Wide Web.

Suggested Reading:

[T1] Alan Dix, Janet Finlay, ―Human Computer Interaction‖, ISBN: 9788131717035 Pearson Education, 2004.
[T2] Ben Shneiderman, ―Designing the User Interface-Strategies for Effective Human Computer Interaction‖, ISBN:9788131732557, Pearson Education , 2010
Suggested readings:
[R1] Usability Engineering: Scenario-Based Development of Human-Computer Interaction, by Rosson, M. and Carroll, J. (2002)
[R2] The Essentials of Interaction Design, by Cooper, et al. , Wiley Publishing(2007)
[R3] Usability Engineering, by Nielsen, J. Morgan Kaufmann, San Francisco, 1993. ISBN 0-12-518406-9
[R4] The Resonant Interface: HCI Foundations for Interaction Design , by Heim, S. , Addison-Wesley. (2007)
[R5] Usability engineering: scenario-based development of human-computer interaction, By Rosson, M.B & Carroll, J.M. , Morgan Kaufman.(2002)

26MCSE22D5 QUANTUM COMPUTING

		Marks	Credits
LTP	**Exam:**	100	4
4- -	**Sessional:**	50	
	Total:	150	4

Duration of Exam: 3 hrs.

NOTE: Examiner will set nine questions in total. Question One will be compulsory and will comprises of all section and remaining eight questions to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT 1

Single quantum systems: State space postulate, Qubitasa column vector, Principal of superposition, Important basis sets in C^2/H^2 (X, Y, and Z basis), Measurement of single-qubit system using Born's rule, Global vs relative phase of quantum state, Bloch sphere (geometrical representation of qubit). Generalized k-level quantum state: qutrits, qudits and measurement of these systems using Born's rule, qubit gates: I, X, Y, Z, Hadamard, Phase gate, S, S dagger, T, T dagger gates, Rotational Gates: RX, RY, RZ Operators and matrices: Evolution, observable, and projection operators, PAULI operators, Operators as outer products, Operators as matrices, Hermitian, unitary, and normal operators/matrices. Unitary transformations, Eigen value and eigen vector of operators, Spectral decomposition, Expectation value of an operator, Introduction to Qis Kit

UNIT 2

Composition of qubits: Tensor product of vectors, Multi-qubit systems, Product state vs entangled state, Bell states, GHZ states, Unitary operations on multi-qubit system, Composition of unitary operation, Other relevant topics discussed Ch. 4 of Book-1.

Multi-qubit gates: CNOT, SWAP, CZ, CP (∅), CU, CCNOT(Toffoli), CCZ, CCU, CSWAP (Fredkin) gates

Quantum circuits: Introduction to classical non-reversible and reversible gates, Revision of single qubit and multi-qubit gates, Quantum circuits, Qubit ordering, Gates in serial, Gates in parallel, Conversion of classical circuits to quantum circuits, Phase kickback

UNIT 3

Measurement Theory: Projection operators, Projective measurements, Measurement in X and Y basis, Measurement of composite system

Quantum Postulates: State space postulate, Time evolution postulate, Composition postulate and Measurement postulates

Quantum Algorithms: Deutsch, Deutsch-Jozsa, Quantum Fourier Transform, Quantum Phase Estimation, Grover's Search, Period/Order finding, Shor's Prime Factorization

UNIT 4

Application of entanglement: Quantum teleportation, Superdense coding, No cloning theorem

Quantum Cryptography: BB84, B92,E91

Quantum Error Correction: 3-qubitbitflip,3-qubit phase flip, Shor's9-qubiterror correction

Book:

1.Quantum Computing Explained by David Mc Mahon

2.Quabtum Computing for Computer Scientists by Yanofskyet.al.

3.Quantum Computation and Quantum information by Nielsenet.al.

22AIML23C1 KNOWLEDGE BASED EXPERT SYSTEMS

Marks	credits			
L T P		**Exam :**	**100**	**4**
4 - -		**Sessional :**	**50**	
Total :	**150**	**4**		

Unit-1

Introduction to Knowledge-Based System: Hierarchy of knowledge pyramid**,** types of knowledge, types of Knowledge-Based Systems. Knowledge Representation: Definition, Knowledge representation schemes: Logic, Semantic Nets, Frames, and Rule-Based System. Comparison of various Knowledge representation schemes.

Unit-2

Logic: Introduction to Logic, Propositional Logic: Syntax, Semantic Tableaux**,** and Inference. First Order Predicate Logic: Syntax, Semantic Tableaux, and Inference. Resolution, Unification, limitation of Logic, forward chaining, Backward chaining, Programming in Prolog.

Unit-3

Expert systems: - Introduction, characteristics of Expert Systems, Expert System Architecture, Inference Engine, Knowledge Acquisition Facilities, Design of Expert Systems, Types of Experts Systems: Dendral ,Mycin, Application of Expert System, advantages and limitations of Expert Systems.

Unit-4

Uncertainty Management in Expert Systems, Introduction to Fuzzy Logic.

Learning: Rote Learning, Learning by Induction, Symbol Based Learning, Identification trees, Explanation Based Learning, Transformational Analogy, Society Based Learning.

References:

1. Artificial Intelligence-Nilsl J Nilson
2. Artificial Intelligence-Elain Rich and Kevin Knight
3. Artificial Intelligence: A modern approach-Staurt Russel and Peter Norvig
4. Artificial Intelligence-Patrick Henry Winston 5. The Essence of Logic- John Kelly

22AIML23C2 AI Ethics

		Marks	Credits
LTP	**Exam:**	100	4
4 --	**Sessional:**	50	
	Total:	150	4
DurationofExam:	3hrs.		

NOTE: Examiner will set nine questions in total. Question One will be compulsory and willcomprises of all section and remaining eight questions to be set by taking two questionsfrom each unit. The students have to attempt five questions in total, first being compulsoryand selecting onefromeachUnit.

Unit 1:

Introduction:
Ethics of AI**,** Benefits & risks of artificial intelligence**,** The singularity, Three Major Singularity Schools,The value alignment problem, Principles for creating safer AI**,** Algorithmic bias: From discrimination discovery to fairness-aware data mining, Ethical Ambiguity of emergent digital world

Unit 2:

AI and State: Data, Individuals, and Society:
Individuals and society, Fairness and bias, ethics, legality, data collection and public use, DemocracyKiller robots, Love Robots, Automation, Self Driving cars, Robots rights, Living with Alien minds**,** Self consciousness and superintelligence, Responsibility, Case Study: Rethinking AI Ethics with Data Activism

Unit 3:

AI and Business: Algorithm Bias
Data biases, Word Embeddings, facial recognition, prediction algorithm, Disinformation, overfitting, causation vs correlation, Fairness infacial recognition, natural language processing, and predictive algorithms, Case study: Algorithmic Transparency in the Public Sector, Law and Regulation of AI: Global Perspective

Unit 4:

AI and Society: Applications, Challenges and Opportunities

Understand conceptions of global governance, corporate social responsibility, decision-makingunder risk, and market failures to investigate issues of global justice raised by AI. Case Study: AI and Nigeria: Exploring Threatsto Human Rights, AI Ethics in the LAC Region,

References:

1. **https://www.ed.ac.uk/files/atoms/files/ethics_of_ai_course_guide_002.pdf**
2. **https://aiethicscourse.org/modules.html**
3. **Rethinking AI Ethics with Data Activism**

22AIML23C3 Seminar

LTP		Marks	Credits
- --	**Sessional:**	50	**2**
2	**Total** :	50	

A candidate has to present a seminar on a recent topic/ technology/ research advancement and has to submit a seminar report. The marks will be given on the basis of seminar report, contents of the presentation, communication and presentation skills.

22AIML22CL2 Knowledge Based Expert System Lab

		Marks	Credits
LTP	**Exam :**	50	2
- -2	**Sessional :**	50	
	Total :	100	2

A student has to perform10-12 practical based on theory paper.

Course Outcomes:

Upon successful completion of this course student will:

CO1. Able to design a knowledge based system,

CO2. Familiar with terminology used in this topical area,

CO3. Read and analyzed important historical and current trends addressing artificial intelligence.

Experiment-1Turbo Prolog features and format.
Experiment-2Write a program using variables in Prolog.
Experiment-3Write a program for usage of rules in Prolog.
Experiment-4Write a program for using Input, Output and fail predicates in prolog.
Experiment-5Write program for studying Usage of Arithmetic operators in Prolog.
Experiment-6Write program to study usage of Cut, Not, Fail predicates in Prolog.
Experiment-7 Write program to study usage of Recursion in prolog.
Experiment-8Write programs to study usage of Logical , Arithmetic ,String operators in Prolog.
Experiment-9WAP for studying usage of Compound Object and List in prolog.
Experiment-10Write a program for studying usage of Dynamic Database in prolog.

22AIML22CL1 Literature Survey (Dissertation Stage 1)

Marks				**Credits**
LTP	**Exam**	**:**	50	2
- -2	**Sessional**	**:**	50	
Total		**:**	100	2

A candidate has to prepare a report covering identification of research topic, literature review, planning of research scheme and systematic documentation. The marks will be given on the basis of a report prepared covering the above said contents, contents of the presentation, communication and presentation skills.

22AIML22CL2 Project

			Marks	**Credits**
LTP	**Exam**	**:**	50	2
- -2	**Sessional**	**:**	50	
	Total	**:**	100	2

At the end of this course the student shall be able to

CO1 have an understanding how software is to be developed
CO2 utilise different models for SDLC
CO3 write detailed project reports
CO4 implement project in a suitable platform

22AIML23C3 DESTERTATION

LTP			**Marks**	**Credits**
-	**External**		**500**	**20**
--	**Internal:**	**250**		
	Total		**750**	20

COURSE OUTCOMES:

By the end of this course every student is expected to be able to

CO1 Handle research problems and use modern research tools/methods.
CO2 Analyse and review the existing literature on a research problem.
CO3 Design and conduct experiments.
CO4 Write dissertation and technical reports.
CO5 Publish research papers.