B. Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning)
Scheme of Studies/Examination (w.e.f. Session 2022-23)
Semester V

S. No	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	PC- CS-AIML- 301A	Automata	3:0:0	3	3	75	25	0	100	3
2	PC- CS-AIML- 303A	Design and Analysis of Algorithms	3:0:0	3	3	75	25	0	100	3
3	ES- CS-AIML- 305A	Computer Network	3:0:0	3	3	75	25	0	100	3
4	PC- CS-AIML- 307A	Artificial Neural Networks	3:0:0	3	3	75	25	0	100	3
5	ES- CS-AIML- 309A	Computer Architecture	3:0:0	3	3	75	25	0	100	3
6	PC- CS-AIML- 311A	Artificial Intelligence and Machine Learning	3:0:0	3	3	75	25	0	100	3
7	PC- CS-AIML- 313A	Artificial Intelligence and Machine Learning Lab	0:0:2	2	1	0	40	60	100	3
8	PC-CS-AIML- 317A	Design and Analysis of Algorithms Lab	0:0:2	2	1	0	40	60	100	3
9	PC- CS-AIML- 315A	Artificial Neural Networks Lab	0:0:2	2	1	0	40	60	100	3
		Total		**24**	**21**	**450**	**270**	**180**	**900**	
10	MC-904A	Energy Resources & Management	3:0:0	3	0	0	100	0	100	3
11	SIM-301A*	Seminar on Summer Internship	2:0:0	2	0	0	50	0	50	-

***Note: SIM-301A is a mandatory credit less course in which the students will be evaluated for the summer internship undergone after fourth semester and students will be required to get passing marks to qualify.**

PC- CS-AIML- 301A	Automata						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hour**
Purpose	**To understand the challenges for Theoretical Computer Science and its contribution to other sciences**						
Course Outcomes							
CO 1	**Students are able to explain and manipulate the different fundamental concepts in automata theory and formal languages.**						
CO 2	**Simplify automata and context-free grammars; Prove properties of languages, grammars and automata with rigorously formal mathematical methods, minimization.**						
CO 3	**Differentiate and manipulate formal descriptions of push down automata, its applications and transducer machines.**						
CO 4	**To understand basic properties of Turing machines and computing with Turing machine, the concepts of tractability and decidability.**						

Unit - I

Introduction to Automata: Study and Central Concepts of Automata Theory, Applications of Finite Automata, An Introduction of Deterministic Finite Automata(DFA) and Non-Deterministic Finite Automata(NFA), Finite Automata with Epsilon (€) Transitions.

Regular Expression and Languages: Regular Expressions (RE), Finite Automata and Regular Expressions,Applications of Regular Expressions, Algebraic Laws of Regular Expressions, Closure Properties of Regular Languages, RE to NFA, DFA Conversion and DFA to RE, Equivalence and Minimization of NFA and DFA automata.

Unit-II

Context free Grammars and Languages: Parse Trees, Context Sensitive Grammar, Context Free Grammar,Regular Grammar, Applications of Context Free Grammars, Ambiguity in Grammars and Languages. Closure Properties of CFL, Chomsky Theorem,ChomskyHierarchy,Normal forms of context free grammars: Chomsky Normal Form, Greibach Normal Form.

Pumping Lemma: Introduction to Pumping Lemma, pumping lemma for context free languages,Applications of Pumping Lemma, Minimization of Finite Automata, and Recursive Language.

Unit-III

Mealey and Moore Machines: Definitions, Representation, Equivalence of Moore and Mealey Machines and its Designing.

Push Down Automata: Introduction of Push Down Automata (PDA), Language of PDA, Equivalence of PDA's and CFG's, Deterministic Push Down Automata, Designing of PDA, Applications of PDA.

Unit-IV

Introduction to Turing Machine: The Turing Machine, Programming Techniques for Turing Machine, Extensions of Turing Machine, Restricted Turing Machines, Universal Turing Machines and Designing of Turing Machines, Time and Tape Complexity Measures of Turing machines

Decidability: Post's Correspondence Problem (PCP), Rice's Theorem, Decidability and Undecidability properties,P-NP class and completeness.

Suggested Books:

- J.E.Hopcroft, R.Motwani and J.D.Ullman , "Introduction to Automata Theory Languages and
- computation", Pearson Education Asia , 2001.
- K.Krithivasan and R.Rama; Introduction to Formal Languages, Automata Theory and Computation; Pearson Education, 2009.
- Peter Linz, "An Introduction to Formal Language and Automata", 4th Edition, Narosa Publishing house , 2006.
- M.Sipser; Introduction to the Theory of Computation; Singapore: Brooks/Cole, Thomson Learning, 1997.
- John.C.martin, "Introduction to the Languages and the Theory of Computation", Third edition, Tata McGrawHill, 2003

PC- CS-AIML-303A	Design and Analysis of Algorithms						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3.0**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To introduce advanced data structures and algorithms concepts involving their implementation for solving complex applications.**						
Course Outcomes (CO)							
CO1	**To introduce the basic concepts of Data Structures and their analysis.**						
CO2	**To study the concept of Dynamic Programming and various advanced Data Structures.**						
CO3	**To introduce various Graph algorithms and concepts of Computational complexities.**						
CO4	**To study various Flow and Sorting Networks**						

Unit 1: Introduction

Review:-Elementary Data Structures, Algorithms and its complexity(Time and Space), Analysing Algorithms, Asymptotic Notations, Priority Queue, Quick Sort.

Recurrence relation:-Methods for solving recurrence(Substitution , Recursion tree, Master theorem), Strassen multiplication.

Unit 2: Advanced Design and analysis Techniques

Dynamic programming:-Elements, Matrix-chain multiplication, longest common subsequence,
Greedy algorithms:- Elements , Activity- Selection problem, Huffman codes, Task scheduling problem, Travelling Salesman Problem.

Advanced data Structures:-Binomial heaps, Fibonacci heaps, Splay Trees, Red-Black Trees.

Unit 3: Graph Algorithms

Review of graph algorithms:-Traversal Methods(Depth first and Breadth first search),Topological sort, Strongly connected components, Minimum spanning trees- Kruskal and Prims, Single source shortest paths, Relaxation, Dijkstras Algorithm, Bellman- Ford algorithm, Single source shortest paths for directed acyclic graphs, All pairs shortest paths- shortest paths and matrix multiplication, Floyd-Warshall algorithm**.**

Computational Complexity:-Basic Concepts, Polynomial Vs Non-Polynomial Complexity, NP- hard and NP-complete classes.

Unit 4: Network and Sorting Algorithms

Flow and Sorting Networks Flow networks, Ford- Fulkerson method, Maximum Bipartite matching, Sorting Networks, Comparison network, The zero- One principle, Bitonic sorting network, Merging networks

Suggested Books :

- Corman, Leiserson and Rivest : Introduction to Algorithms, 2/e, PHI
- Das Gupta :Algorithms, TMH.
- Horowitz, Ellis and Sahni, Sartaj: Fundamentals of Computer Algorithms. Galgotia Publications
- Aho, Hopcroft and Ullman: The Design and Analyses of Computer Algorithms. Addison Wesley.
- R.B.Patel: Expert Data Structures with C, Khanna Publications , Delhi, India, 2nd Edition 2004, ISBN 81-87325-07-0.
- R.B.Patel and M.M.S Rauthan: Expert Data Structures with C++, Khana Publications, Delhi , India, 2nd Edition 2004,ISBN 87522-03-8

ES- CS-AIML- 305A	Computer Network						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To introduce the architecture and layers of computer network, protocols used at different Layers.						
Course Outcomes(CO)							
CO1	To understand the basic concept of networking, types, networking topologies and layered architecture.						
CO2	To understand data link layer and MAC sub-layer`						
CO3	To understand the network Layer functioning						
CO4	To understand the transport layer and application layer operation						

Unit -I

Introduction to Computer Networks : Data Communication System and its components, Data Flow, Computer network and its goals, Types of computer networks: LAN, MAN, WAN, Wireless and Wired networks, broadcast and point-to-point networks, Network topologies, protocols, interfaces and services, ISO- OSI reference model, TCP/IP architecture.
Physical Layer: Concept of Analog & Digital Signal, Bandwidth, Transmission Impairments: Attenuation, Distortion, Noise, Multiplexing : Frequency Division, Time Division, Wavelength Division, Transmission Media: Twisted pair, Coaxial cable, Fiber optics, Wireless transmission (radio, microwave, infrared), Switching: Circuit Switching, Message Switching ,Packet Switching & comparisons, narrowband ISDN, broadband ISDN.

Unit -II

Data link layer: Error Control, Types of errors, framing(character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, sliding window protocols, Selective repeat ARQ, HDLC;
Medium access sub layer: Point to point protocol, FDDI, token bus, token ring; Reservation, polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, FDMA, TDMA, CDMA, LLC, Traditional Ethernet, fast Ethernet, Network devices-repeaters, hubs, switches, Bridges, Router, Gateway .

Unit-III

Network layer: Addressing : Internet address, sub-netting; Routing techniques, static vs. dynamic routing , routing table, DHCP, IEEE standards 802.x, Routing algorithms: shortest path algorithm, flooding, distance vector routing, link state routing; Protocols: ARP, RARP, IP, ICMP, IGMP, IPV6; Unicast and multicast routing protocols, ATM.

Unit-IV

Transport layer: Process to process delivery; UDP; TCP, RPC, Congestion control algorithm: Leaky bucket algorithm, Token bucket algorithm, choke packets; Quality of service: techniques to improve QoS.
Application layer: DNS; SMTP, SNMP, FTP, HTTP & WWW; Firewalls, Bluetooth, Email, S/MIME, IMAP,
Network Security: Cryptography, user authentication, security protocols in internet, public key encryption algorithm, digital signatures.

Suggested Books:

- Behrouz A. Forouzan, “Data communication and Networking”, Tata McGraw Hill, Fourth Edition, 2011.
- Computer Networks, 4th Edition, Pearson Education by Andrew S. Tanenbaum
- Larry L.Peterson, Peter S. Davie, “Computer Networks”, Elsevier, Fifth Edition, 2012.
- William Stallings, “Data and Computer Communication”, Eighth Edition,Pearson Education, 2007.
- James F. Kurose, Keith W. Ross, “Computer Networking: A Top–Down Approach Featuring the Internet”, Pearson Education, 2005.

PC- CS-AIML-307A	Artificial Neural Networks						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To provide knowledge of various artificial neural networks, deep neural networks, and fuzzy logic techniques.**						
Course Outcomes (CO)							
CO1	To learn the basics of artificial neural networks concepts.						
CO2	Expose detailed explanation of various neural networks architecture.						
CO3	To explore knowledge of special types of Artificial neural networks.						
CO4	To explore deep neural networks and fuzzy logic techniques.						

Unit I

Fundamentals of Artificial Neural Networks

Introduction: Concepts of neural networks, Characteristics of Neural Networks, Applications of Neural Networks. Fundamentals of Neural Networks: The biological prototype, Neuron concept, Single layer Neural Networks, Multi-Layer Neural Networks, terminology, Notation and representation of Neural Networks, Training of Artificial Neural Networks. Representation of perceptron, perceptron learning and training, Classification, linear Separability

Unit II

Neural Networks

Hopfield nets: Structure, training, and applications, Back Propagation: Concept, Applications and Back Propagation Training Algorithms. Counter Propagation Networks: Kohonan Network, Grossberg Layer & Training, applications of counter propagation, Image classification.

Bi-directional Associative Memories: Structure, retrieving a stored association, encoding associations.

Unit III

Special Neural Networks

ART: ART architecture, ART classification operation, ART implementation and characteristics of ART. Image Compression Using ART, Optical Neural Networks: Vector Matrix Multipliers, Hop field net using Electro optical matrix multipliers, Holographic correlator, Optical Hopfield net using Volume Holograms, Cognitrons and Neocognitrons: structure and training.

Unit-IV

Deep Learning Neural Networks

Deep Networks: CNN, RNN, LSTM, Attention layers, Applications, Techniques to improve deep networks: DNN Optimization, Regularization, AutoML.

Suggested Books:

- Li Min Fu, "Neural Networks in Computer Intelligence", McGraw-Hill, Inc. 2012.
- S N Sivanandam, "Neural Networks using MATLAB 6.0", TMH, 4th. Reprint 2015.
- Freeman J.A. & D.M. Skapura, "Neural Networks: Algorithms, Applications and Programming Techniques", Addison Wesley, Reading, Mass, 2014.
- Deep Learning (Ian J. Goodfellow, YoshuaBengio and Aaron Courville), MIT Press, 2016.
- Deep Learning with Python: A Hands-On Introduction by Ketkar, Apress
- François Chollet, Fundamentals of Deep Learning: Designing next-generation machine intelligence algorithms, Manning Publications, 2017

ES- CS-AIML- 309A	Computer Architecture						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	Student will be able to understand the basic concepts of computer architecture and organization, and understand the key skills of constructing cost-effective computer systems.						
Course Outcomes (CO)							
CO1	Be familiar with the internal organization and operations of a computer.						
CO2	Be familiar with the design trade-offs in designing and constructing a computer processor.						
CO3	Be aware with the CPU design including the RISC/CISC architectures.						
CO4	Be acquainted with the basic knowledge of I/O devices and Select the appropriate interfacing standards for I/O devices.						

Unit- I

Data representation and Computer arithmetic: Introduction to Computer Systems, Organization and architecture, Von Neumann Architecture,evolution and computer generations; Fixed point representation of numbers, digital arithmetic algorithms for Addition, Subtraction, Multiplication using Booth's algorithm and Division using restoring and non restoring algorithms. Floating point representation with IEEE standards and its arithmetic operations.
Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory.

Unit-II

Basic Computer organization and Design: Instruction codes, stored program organization, computer registers and common bus system, computer instructions, timing and control, instruction cycle: Fetch and Decode, Register reference instructions; Memory reference instructions. Input, output and Interrupt: configuration, instructions, Program interrupt, Interrupt cycle, Micro programmed Control s
organization, Control Memory, address sequencing, Micro program Example, micro instruction format, Horizontal Vs Vertical micro-programming, design of control Unit, microprogram sequencer, Hardwired v/s Micro-programmed Control Unit.

Unit-III

Central Processing Unit: General register organization, stack organization, instruction formats (Zero, One, Two and Three Address Instruction), addressing modes, Data transfer and manipulation, Program control. CISC and RISC: features and comparison. Pipeline and vector Processing , Parallel Processing, Flynn's taxonomy, Pipelining, Instruction Pipeline, Basics of vector processing and Array Processors.

Unit-IV

Input-output organization: I/O interface. I/O Bus and interface modules, I/O versus Memory Bus. Asynchronous data transfer: Strobe control, Handshaking, Asynchronous serial transfer. Modes of Transfer: Programmed I/O, Interrupt driven I/O, Priority interrupt; Daisy chaining, Parallel Priority interrupt. Direct memory Access, DMA controller and transfer. Input output Processor , CPU-IOP communication, Serial communication.

Suggested Books:

- William Stallings, "Computer Organization and Architecture – Designing for Performance", Sixth Edition, Pearson Education, 2003.
- Morris Mano, M., "Computer System Architecture," 3/e, Pearson Education, 2005.
- John P. Hayes, "Computer Architecture and Organization," 3/e, TMH, 1998.
- David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Third Edition, Elsevier, 2005.
- V.P. Heuring, H.F. Jordan, "Computer Systems Design and Architecture", Second Edition, Pearson Education, 2004.
- Carl Hamacher, ZvonkoVranesic and SafwatZaky, "Computer Organization", Fifth Edition, Tata McGraw Hill, 2002.

PC-CS-AIML-311A	Artificial Intelligence and Machine Learning						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	The main purpose of this subject is to provide the most fundamental knowledge of Artificial Intelligence and Machine Learning						
Course Outcomes (CO)							
CO1	Demonstrate fundamental understanding of Artificial Intelligence (AI) and its foundation						
CO2	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning						
CO3	Demonstrate proficiency in applying scientific method to models of machine learning						
CO4	Apply basic principles of ML Algorithms and Models; regression, classification, and clustering.						

UNIT – I

Scope of AI: Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems, AI techniques-search knowledge, abstraction.

Problem Solving: State space search; production systems, search space control; depth first search, breadth-first search. Heuristic Based Search: Heuristic search, Hill climbing, best-first search,A*Algorithm and AO* algorithm, Min-max algorithms, game playing – Alpha beta pruning branch and bound, Problem Reduction, Constraint Satisfaction End, Means-End Analysis.

UNIT – II

Game Playing: Game Tree, Minimax Algorithm, Alpha Beta Cutoff, Modified Minimax Algorithm, Horizon Effect, Futility Cut-off.

Knowledge Representation: Predicate Logic: Unificatioin, Modus Ponens, Modus Tolens, Resolution in Predicate Logic, Conflict Resolution Forward Chaining, Backward Chaining, Declarative and Procedural Representation, Rule based Systems.

Structured Knowledge Representation: Semantic Nets: Slots, exceptions and default frames, conceptual dependency.

UNIT – III

Knowledge Engineering: First order logic, Syntax and semantics for first order logic, Inference in First order logic – prepositional versus first order logic, unification and lifting, forward chaining, backward chaining , Resolution, Knowledge representation

Handling Uncertainty: Non-Monotonic Reasoning, Probabilistic reasoning, use of certainty factors, fuzzy logic.

Natural Language Processing: Introduction, Syntactic Processing, Semantic Processing, Pragmatic Processing.

UNIT – IV

Machine Learning:

Introduction to Machine Learning, Different Paradigms of Machine Learning, Applications of Machine Learning, An overview of the design cycle and issues in machine learning, well-posed machine learning problems, examples of applications in diverse fields.

Unsupervised Learning, K-Means Clustering, Hierarchical Clustering, Density-Based Clustering

SUGGESTED BOOKS:

- E. Rich and K**.** Knight, "Artificial Intelligence", **McGraw** Hill Education; 3rd edition, 2017.
- N. J. Nilsson, "Principles of AI", Narosa Publ. House, 1990.
- EthemAlpaydin, Introduction to Machine Learning, Second Edition
- Introduction to Machine Learning with Python: A Guide for Data Scientists 1st Edition by Andreas C. ...
- M. N. Hoda, "Foundation Course in Artificial Intelligence", Vikas Pub., 2004.
- Miroslav Kubat, An Introduction to Machine Learning, Springer, 3rd ed. 2021.
- P. H. Winston, "Artificial Intelligence", Pearson Education, 3rd Edition, 2002. Artificial Intelligence.

- D. W. Patterson, “Introduction to AI and Expert Systems”, PHI, 1992.
- R. J. Schalkoff, “Artificial Intelligence – An Engineering Approach”, McGraw Hill Int. Ed. Singapore, 1992.
- M. Sasikumar, S. Ramani, “Rule Based Expert Systems”, Narosa Publishing House, 1994. 5. Tim Johns, “Artificial Intelligence, Application Programming, Wiley Dreamtech, 2005.
- 5.Stephen Marsland, Machine Learning: An Algorithmic Perspective.
- Christopher M. Bishop, Pattern Recognition and Machine Learning.

PC- CS-AIML-313A	Artificial Intelligence and Machine Learning Lab						
Lecture	**Tutorial**	**Practical**	**Credits**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	**To implement the basic concepts of Artificial Intelligence problems as well as basic concepts of Machine Learning.**						
Course Outcomes (CO)							
CO1	To implement the search space problems.						
CO2	To formulate and implement the game problems.						
CO3	To implement the various classifiers on different dataset						
CO4	To implement the clustering algorithms						

1. Write a program to implement BFS and DFS.
2. Write a program to implement A* algorithm.
3. Write a program to implement AO* algorithm.
4. Write a program to implement Hill Climbing Approach.
5. Write a program to implement the Min Max Strategy.
6. Write a program for defining Array using numpy.
7. Write a program to Create data frames in python using Pandas Package and also implement its features, how to read csv file.
8. Write a program for Data cleaning using pandas.
9. Write a program for data visualization using matplotlib and seaborn library.
10. Write a program for classification of an object by implementing scikit-library.

PC-CS-AIML-317A	Design and Analysis of Algorithms Lab						
Lecture	**Tutorial**	**Practical**	**Credits**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3**
Purpose	The student should be made to Learn the algorithm analysis techniques, become familiar with the different algorithm design techniques and Understand the limitations of Algorithm power.						
Course Outcomes (CO)							
CO1	The student should be able to Design algorithms for various computing problems.						
CO2	The student should be able to Analyze the time and space complexity of algorithms.						
CO3	The student should be able to Critically analyze the different algorithm design techniques for a given problem.						
CO4	The student should be able to Modify existing algorithms to improve efficiency.						

1. Sort a given set of elements using the Quick sort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the lIst to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.

2. Using Open, implement a parallelized Merge Sort algorithm to sort a given set of elements and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.

3. a. Obtain the Topological ordering of vertices in a given digraph.

   b. Compute the transitive closure of a given directed graph using Warshall's algorithm.

4. Implement 0/1 Knapsack problem using Dynamic Programming.

5. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.

6. Find Minimum Cost Spanning Tree of a given undirected graph using Kristal's algorithm.

7. a. Print all the nodes reachable from a given starting node in a digraph using BFS method.

   b. Check whether a given graph is connected or not using DFS method.

8. Find a subset of a given set S = {sl,s2,.....,sn} of n positive integers whose sum is equal to a given positive integer d. For example, if S= {1, 2, 5, 6, 8} and d = 9 there are two solutions{1,2,6}and{1,8}.A suitable message is to be displayed if the given problem instance doesn't have a solution.

9. Implement any scheme to find the optimal solution for the Traveling Salesperson problem and then solve the same problem instance using any approximation algorithm and determine the error in the approximation.

10. Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.

11. Implement All-Pairs Shortest Paths Problem using Floyd's algorithm. Parallelize this algorithm, implement it using Open and determine the speed-up achieved.

12. Implement N Queen's problem using Back Tracking.

13. Use divides and conquers method to recursively implement Binary Search

MC-904A	Energy Resources & Management						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**-**	**0**	**-**	**100**	**100**	**3**
Purpose	To make the students conversant with the basics concepts and conversion of various form of Energy						
COURSE OUTCOMES							
CO1	An overview about Energy Resources, Conventional and Non-conventional sources						
CO2	Understand the Layout and working of Conventional Power Plants						
CO3	Understand the Layout and working of Non-Conventional Power Plants						
CO4	To understand the Energy Management, Audit and tariffs, Role of Energy in Economic development and Energy Scenario in India						

UNIT-I

Introduction: Types of energy, Conversion of various forms of energy, Conventional and Non-conventional sources, Need for Non-Conventional Energy based power generation.

UNIT-II

Conventional Energy sources: Types ofConventional Energy sources, Selection of site**,** working of Thermal, Hydro, Nuclear and Diesel power plants and their schematic diagrams & their comparative advantages/ disadvantages.

UNIT-III

Non-Conventional Energy sources: Types ofNon-Conventional Energy sources , Basic principle, site selection of Solar energy power plant, photovoltaic technologies, PV Systems and their components, Wind energy power plant , Bio energy plants ,Geothermal energy plants and Tidal energy plants.

UNIT-IV

Energy Management: General Principles of Energy Management, Energy Management Strategy, Modern trends and developments towards Computerizations of Power System.

Energy Audit: Need, Types, Methodology and Approach.

Energy Scenario: Lay out of power system, Role of Energy in Economic development, energy demand, availability and consumption, Indian energy scenario, long term energy scenario, energy sector reforms in India, energy strategy for the future.

Suggested Books:

- Energy Studies-Wiley Dream Tech India.
- Non-conventional energy resources- Shobhnath Singh, Pearson.
- Electrical Power Systems :Soni, Gupta, Bhatnagar – Dhanpat Rai & Sons
- NEDCAP: Non Conventional Energy Guide Lines
- Non conventional energy sources : G.D. Roy
- Non Conventional energy resources :B H Khan - McGraw Hill
- Applied Solar Energy :Meinel A B - Addison Wesley Publications
- Direct Energy ConversionGeorge: Sutton –McGraw

PC- CS-AIML-315A	Artificial Neural Networks Lab						
Lecture	**Tutorial**	**Practical**	**Credits**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	The purpose of this lab is to make students familiar with basic concepts and tool used in neural networks, teach students structure of a neuron including biological and artificial and concepts of learning						
Course Outcomes (CO)							
CO1	To implement the basic mathematical operations using neural network.						
CO2	To design single and multi-layer feed-forward neural network						
CO3	To understand supervised and unsupervised learning concepts & understand unsupervised learning using Neural networks.						
CO4	To understand the training of recurrent Hopfield networks and associative memory concepts.						

1. Perform elementary mathematical operations like addition, multiplication, division and exponentiation.
2. Create, initialize, and display simple variables and simple strings and use simple formatting for variable.

3. Create/Define single dimension / multi-dimension arrays, and arrays with specific values like array of all ones, all zeros, array with random values within a range, or a diagonal matrix.

4. Use command to compute the size of a matrix, size/length of a particular row/column, load data from a text file, store matrix data to a text file, finding out variables and their features in the current scope

5. Write a program to generate XOR function using McCulloch-Pitt's neuron and appropriate values for weights, bias, and threshold.
6. Write a program for perceptron net for an AND function with bipolar inputs and targets.

7. Write a program to recognize the number from 0,1,2, 3...,9. A number is represented as a 5×3 matrix of 0 and 1. For any valid point it is taken as 1 and invalid point it is taken as 0. The net has to be trained to recognize all the numbers and when the test data is given. The file number.mat has three components, as: • input-data: The training data. Each column represents a number. • output-data: A 10×10 matrix of desired outputs. • test-data: Test data. Each column is a test vector.

8. Write a program (with a suitable example) to demonstrate how the hyperplane is changing in diff erent iterations using the perceptron learning law with its decision regions. Give the output in graphical form.

9. Write a program to compress the data given in the data file using a multilayer feedforward neural network and back propagation.

10. Use some function for neural networks, like Stochastic Gradient Descent or backpropagation - algorithm to predict the value of a variable based on the dataset of different features of student's data, classify, whether a student is suitable for a particular activity. Based on the available dataset, a student can also implement another classification problem like checking whether an email is spam or not.

11. Predicting Bike-Sharing Patterns Build and train neural networks from scratch to predict the number of bikeshare users on a given day
Design and train a convolutional neural network to analyze images of dogs and correctly identify their breeds. Use transfer learning and well-known architectures to improve this model—this is excellent preparation for more advanced applications.

B. Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning)
Scheme of Studies/Examination (w.e.f. Session 2022-23)
Semester VI

S. No.	Course No.	Subject	L:T:P	Hours / Week	Credits	Examination Schedule				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	PC-CS-AIML- 302A	Human Computer Interaction	3:0:0	3	3	75	25	0	100	3
2	PC- CS-AIML- 304A	Applied Machine Learning	3:0:0	3	3	75	25	0	100	3
3	PC- CS-AIML- 306A	Expert Systems	3:0:0	3	3	75	25	0	100	3
4	PC-CS-AIML-308A	Software Testing	3:0:0	3	3	75	25	0	100	3
5	PC- CS-AIML- 310A	Computer Vision	3:0:0	3	3	75	25	0	100	3
6	OEC	OEC Elective-I	3:0:0	3	3	75	25	0	100	3
7	PC- CS-AIML- 312A	Applied Machine Learning Lab	0:0:2	2	1	0	40	60	100	3
8	PC- CS-AIML- 314A	Expert Systems Lab	0:0:2	2	1	0	40	60	100	3
9	PC- CS-AIML- 318A	Software Testing Lab	0:0:2	2	1	0	40	60	100	3
		Total		**24**	**21**	**450**	**270**	**180**	**900**	

OEC Elective-I
Soft Skills and Interpersonal Communication: OE-CS- AIML -302
Project Management: OE-CS- AIML -304
Enterprise Resource Planning: OE-CS- AIML -306
Stochastic Processes and Applications: OE-CS- AIML -308

***The students will choose any One Open Elective course out of the given elective list in VI Semester.**

PC CS- -AIML-302A	Human Computer Interaction						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	Objective of this course is to learn the foundations of Human Computer Interaction and be familiar with the design technologies for individuals and persons with disabilities and mobile Human Computer interaction.						
Course Outcomes (CO)							
CO1	To develop the foundations of Human Computer Interaction						
CO2	To learn and apply the design technologies for individuals and persons with disabilities						
CO3	To Understand the structure of models and theories of human computer interaction and vision						
CO4	To Design an interactive web interface on the basis of models studied.						

Unit 1

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

Unit 2

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.

Unit 3

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

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.

Unit 4

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

Suggested Books:

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

PC- CS-AIML-304A	Applied Machine Learning						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	Objective of this course is to learn conceptually how Machine Learning algorithms work and interact with data; the emphasis will be on effective methodology for using Machine Learning to solve practical problems.						
Course Outcomes (CO)							
CO1	To develop an understanding of where and how Machine Learning can be used.						
CO2	To learn and apply supervised learning techniques to regression and classification problems						
CO3	To understand and apply the concept of KNN and SVM.						
CO4	To learn and apply unsupervised Machine Learning techniques.						

Unit-1

Introduction-Data representation, domain knowledge for productive use of machine learning, diversity of data: structured/unstructured, machine learning and data mining, basic linear algebra in machine learning techniques, relevant resources for machine learning.

Supervised learning: rationale and basics, learning from observations, bias and variance, why learning works: computational learning theory, occam's razor principle and overfitting avoidance, heuristic search in inductive learning, estimating generalization errors, metrics for assessing regression (numeric prediction) accuracy, metrics for assessing classification (pattern recognition) accuracy, Model selection and validation: Validation for model selection, k-fold cross-validation, Training Validation-Testing split.

Unit-2

Regression: Linear regression, linear regression with least square error criterion, Multiple linear regression, Polynomial regression, Logistic regression, logistic regression for classification tasks, fisher's linear discriminant and thresholding for classification, minimum description length principle**,** Gradient Descent: Introduction, Stochastic Gradient Descent, Sub gradients, Stochastic Gradient Descent for risk minimization.

Classification: Decision Tree algorithms, Random forests, Decision tree learning, Building a decision tree, combining weak to strong learners via random forest. Regularized loss minimizationmachine learning and inferential statistical analysis, descriptive statistics in learning techniques, Bayesian reasoning: a probabilistic approach to inference.

Unit-3

K-Nearest Neighbor (KNN) Algorithm, Naive Bayes, Linear Discriminant Analysis, Latent variables and Expectation-maximization algorithm, Bayesian learning Feature Selection and Generation: Feature selection, Feature transformations, Feature learning.

Learning with support vector machines (SVM)-introduction, linear discriminant functions for binary classification, perceptron algorithm, linear maximal margin classifier for linearly separable data, linear soft margin classifier for overlapping classes, kernel-induced feature spaces, nonlinear classifier, regression by support vector machines, decomposing multiclass classification problem into binary classification tasks, variants of basic SVM techniques

Unit-4

Unsupervised Learning-unsupervised learning, engineering the data, overview of basic clustering methods- means clustering, k-means clustering, expectation-maximization (EM) algorithm and gaussian mixtures clustering, some useful data transformations, Dimensionality reduction: Principal Component Analysis, Random projections, Compressed sensing entropy–based method for attribute discretization, principal components analysis (PCA) for attribute reduction, rough sets-based methods for attribute reduction.

Suggested Books:

- M. Gopal, Applied Machine learning, McGraw-Hill Education, 2019
- David Forsyth, Applied Machine learning, Springer, 2019
- Pascal Bugnion, Patrick R. Nicolas, Alex Kozlov, Scala: Applied Machine Learning, Packt Publishing, 1st Edition, 2017

PC- CS-AIML-306A	Expert Systems						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**In this course the student will learn the methodologies used to transfer the knowledge of a human expert into an intelligent program that can be used to solve real-time problems.**						
Course Outcomes (CO)							
CO1	Examining the fundamentals and terminologies of expert system.						
CO2	To explore knowledge of expert system.						
CO3	To facilitate students to implement various knowledge representation techniques for acquisition and validate various structures in expertssystem domain.						
CO4	Signifying AI techniques to solve social, industrial, and environmental problems.						
CO5	Application of professional aspects in multi-disciplinary approach to meet global standards towards design, realizing and manufacturing.						

Unit-I

Introduction to AI programming languages, Blind search strategies, Breadth first – Depth first – Heuristic search techniques Hill Climbing – Best first – A Algorithms AO* algorithm – game tress, Min-max algorithms, game playing – Alpha beta pruning.

Knowledge representation issues predicate logic – logic programming Semantic nets- frames and inheritance, constraint propagation; Representing Knowledge using rules, Rules based deduction systems.

Unit-II

Introduction to Expert Systems, Difference between expert system and conventional programs, Basic activities of expert system, Interpretation, Prediction, Diagnosis, Design, Planning, Monitoring, Debugging, Repair, Instruction, Control, Basic aspect of expert system, Acquisition module frames, Knowledge base, Production rules- semantic net, Inference Engine- Backward chaining and forward chaining-Explanatory interface,types of problems handled by expert systems.

Unit-III

Expert System Tools: Techniques of knowledge representations in expert systems, knowledge engineering, System-building aids, support facilities, stages in the development of expert systems.

Building an Expert System: Expert system development, Selection of tool, acquiring Knowledge, Building process.

Unit-IV

Problems with Expert Systems: Difficulties, common pitfalls in planning, dealing with domain expert, difficulties during development.

Case studies on Expert systems

Suggested Books:

- Elain Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw-Hill, New Delhi, 2009.
- Waterman D.A., "A Guide to Expert Systems", Addison Wesley Longman, 1985
- Staurt Russel and other Peter Norvig, "Artificial Intelligence – A Modern Approach", Prentice Hall, 1995.
- Introduction To Expert Systems, Addison-Wesley; 3rd edition ,1999
- Introduction to Expert Systems: The Developments and Implementation of Rule-based Expert Systems, McGraw-Hill Inc, 1990
- Patrick Henry Winston, "Artificial Intelligence", Addison Wesley, 1992, 3rd Ed..
- Patterson, Artificial Intelligence & Expert System, Prentice Hall India,1999.
- Hayes-Roth, Lenat and Waterman: Building Expert Systems, Addison Wesley, 1983.
  Weiss S.M. and Kulikowski C.A., "A Practical Guide to Designing Expert Systems", Rowman &Allanheld, New Jersey, 2011.

PC-CS-AIML-308A	Software Testing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To provide an understanding of concepts and techniques for testing software and assuring its quality.**						
	Course Outcomes						
CO 1	Expose the criteria and parameters for the generation of test cases.						
CO 2	Learn the design of test cases and generating test cases.						
CO 3	Be familiar with test management and software testing activities and V&V activities.						
CO 4	Be exposed to the significance of software testing in web and Object orient techniques.						

Unit-I

Introduction: Overview of software evolution, SDLC, Testing Process, Terminologies in Testing: Error, Fault, Failure, Verification, Validation, Difference between Verification and Validation, Definition of software testing, test cases, test oracles, testing process, limitations of testing.

Unit-II

Functional Testing: Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique.

Structural Testing: Path testing, DD-Paths, Cyclomatic Complexity, Graph Metrics, Data Flow Testing, Mutation testing.

Unit-III

Reducing the number of test cases: Prioritization guidelines, Priority category, Scheme, Risk Analysis, Regression Testing and Slice based testing.

Testing Activities: Unit Testing, Levels of Testing, Integration Testing, System Testing, Debugging, Domain Testing.

Unit-IV

Overview of SQM: Concepts of Software Quality, quality attributes, software quality models: McCall, Boehm, ISO-9000, CMM.

Misellaneous Topics: Stress testing, Adhoc testing, Buddy testing, Exploratory testing, Agile and extreme testing.

Suggested Books:

- Naresh Chauhan, "Softearw Testing Principles and Practices" Oxford publications, 2012.
- William Perry, "Effective Methods for Software Testing", John Wiley & Sons, New York, 1995.
- CemKaner, Jack Falk, Nguyen Quoc, "Testing Computer Software", Second Edition, Van Nostrand Reinhold, New York, 1993.
- Boris Beizer, "Software Testing Techniques", Second Volume, Second Edition, Van Nostrand Reinhold, New York, 1990.
- Louise Tamres, "Software Testing", Pearson Education Asia, 2002
- Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Fifth Edition, McGraw-Hill International Edition, New Delhi, 2001.
- Boris Beizer, "Black-Box Testing – Techniques for Functional Testing of Software and Systems", John Wiley & Sons Inc., New York, 1995.
- K.K. Aggarwal & Yogesh Singh, "Software Engineering", New Age International Publishers, New Delhi, 2003.

- Marc Roper, “Software Testing”, McGraw-Hill Book Co., London, 1994.

PC-CS- AIML-310A	Computer Vision						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To provide an understanding of concepts and techniques for computer vision**						
	Course Outcomes						
CO 1	To develop the foundation of image formation, measurement, and analysis						
CO 2	To developed the practical skills necessary to build computer vision applications						
CO 3	the geometric relationships between 2D images and the 3D world.						
CO 4	To have gained exposure to object and scene recognition and categorization from images						

Unit 1

Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis.

Unit 2

Edge detection, Edge detection performance, Hough transform, corner detection, Segmentation, Morphological filtering, Fourier transform.

Unit 3

Feature extraction, shape, histogram, color, spectral, texture, using CVIPtools, Feature analysis, feature vectors, distance /similarity measures, data pre-processing.

Unit 4

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

Suggested Books:

- Richard Szeliski, “Computer Vision: Algorithms and Applications”
- Goodfellow, Bengio, and Courville, “Deep Learning”
- Fisher et al., “Dictionary of Computer Vision and Image Processing”

OE-CS-AIML-302	Soft Skills and Interpersonal Communication						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hour**
Purpose	To Develop broad career plans, evaluate the employment market, identify the organizations to get good placement, match the job requirements and skill sets.						
Course Outcomes (CO)							
CO1	Develop effective communication skills (spoken and written).						
CO2	Develop effective presentation skills.						
CO3	Conduct effective business correspondence and prepare business reports which produce results.						
CO4	Become self-confident individuals by mastering inter-personal skills, team management skills, and leadership skills.						

Unit I

Introduction, Need for Communication, Process of Communication - Written and Verbal Communication, Visual communication, Signs, Signals and Symbols, Silence as a Mode of Communication - Inter-cultural, Intra-cultural, Cross-cultural and International communication - Communications skills, Communication through Questionnaires, Business Letter Writing, Electronic Communication. Barriers to Communication Improving Communication Skills -Preparation of Promotional Material -Non-verbal communication -Body language - Postures and gestures -Value of time -Organizational body language - Importance of Listening -Emotional Intelligence

Unit II

Business Cases and Presentations, Letters within the Organizations, Letters from Top Management, Circulars and Memos - Business Presentations to Customers and other stakeholders, Presenting a Positive Image through Verbal and Non-verbal Cues, Preparing and Delivering the Presentations, Use of Audio-visual Aids - Report Writing

Unit III

Individual Interaction and skills Basic Interaction Skills –Within family, Society Personal and interpersonal intrapersonal skills Types of skills; conceptual, supervisory, technical, managerial and decision making skills. Problem Solving, Lateral Thinking Self Awareness and Self Esteem Group Influence on Interaction Skills Human relations examples through role – play and cases

Unit IV:

Leadership Skills Working individually and in a team Leadership skills 15 Lectures Leadership Lessons through Literature Team work & Team building Interpersonal skills – Conversation, Feedback, Feed forward Interpersonal skills – Delegation, Humor, Trust, Expectations, Values, Status, Compatibility and their role in building team – work Conflict Management – Types of conflicts, how to cope with them Small cases including role – plays will be used as teaching methodology.Negotiation Skills (To be Taught through Role Plays and Cases) Types of Negotiation Negotiation Strategies Selling skills – Selling to customers Selling to Superiors Selling to peer groups, team mates & subordinates Conceptual selling, Strategic selling Selling skills – Body language.

Suggested Books:

- A Practical Guide to Soft Skills Communication, Psychology, and Ethics for Your Professional Life by Richard Almonte, Taylor & Francis.

OE-CS- AIML - 304	Project Management						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To provide an understanding of Software Project Planning and Evaluation techniques.**						
	Course Outcomes						
CO 1	To Understand Project Management principles while developing software.						
CO 2	To manage software projects and control software deliverables.						
CO 3	To Obtain adequate knowledge about software process models and software effort estimation techniques.						
CO 4	To Learn staff selection process and the issues related to people management.						

UNIT I PROJECT EVALUATION AND PROJECT PLANNING

Importance of Software Project Management – Activities - Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.

UNIT II PROJECT LIFE CYCLE AND EFFORT ESTIMATION

Software process and Process Models – Choice of Process models - Rapid Application development – Agile methods – Dynamic System Development Method – Extreme Programming– Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points - COCOMO II - a Parametric Productivity Model.

UNIT III ACTIVITY PLANNING AND RISK MANAGEMENT

Obje;ctives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning –Risk Management – – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical paths – Cost schedules.

UNIT IV PROJECT MANAGEMENT AND CONTROL

Framework for Management and control – Collection of data – Visualizing progress – Cost monitoring – Earned Value Analysis – Prioritizing Monitoring – Project tracking – Change control – Software Configuration Management – Managing contracts – Contract Management.

SUGGESTED BOOKS:

- Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.
- Robert K. Wysocki ―Effective Software Project Management‖ – Wiley Publication, 2011
- Walker Royce: ―Software Project Management‖- Addison-Wesley, 1998.
- Gopalaswamy Ramesh, ―Managing Global Software Projects‖ – McGraw Hill Education (India), Fourteenth Reprint 2013.

OE-CS-AIML - 306	Enterprise Resource Planning						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To provide an understanding of concept of ERP and the ERP model;key terms; the transition from MRP to ERP; identify the levels of ERP maturity.**						
	Course Outcomes						
CO 1	To Develop model for ERP for large projects						
CO 2	To Develop model for E-commerce architecture for any application						
CO 3	To Demonstrate a working knowledge of how data and transactions are integrated in an ERP system to manage the sales order process, production process, and procurement process.						
CO 4	To Evaluate organizational opportunities and challenges in the design system within a business scenario.						

Unit I

ERP Introduction, Benefits, Origin, Evolution and Structure: Conceptual Model of ERP, the Evolution of ERP, the Structure of ERP.
Business Process Reengineering, Data ware Housing, Data Mining, Online Analytic Processing (OLAP), Product Life Cycle Management (PLM), LAP, Supply chain Management.

Unit II

ERP Marketplace and Marketplace Dynamics: Market Overview, Marketplace Dynamics, the Changing ERP Market. ERP- Func-tional Modules: Introduction, Functional Modules of ERP Software, Integration of ERP, Supply chain and Customer Relationship Applications.

Unit III

ERP Implementation Basics, ERP Implementation Life Cycle, Role of SDLC/SSAD, Object Oriented Architecture, Consultants, Vendors and Employees.

Unit IV

ERP & E-Commerce, Future Directives- in ERP, ERP and Internet, Critical success and failure factors, Integrating ERP into organizational culture. Using ERP tool: either SAP or ORACLE format to case study.

SUGGESTED BOOKS

- Vinod Kumar Garg and Venkitakrishnan N K, “Enterprise Resource Planning Concepts and Practice”, PHI.
- Joseph A Brady, Ellen F Monk, Bret Wagner, “Concepts in Enterprise Resource Planning”, Thompson Course Technology.
- Alexis Leon, “ERP Demystified”, Tata McGraw Hill
- Rahul V. Altekar “Enterprise Resource Planning”, Tata McGraw Hill,
- Vinod Kumar Garg and Venkitakrishnan N K, “Enterprise Resource Planning – A Concepts and Practice”, PHI
- Mary Summer, “Enterprise Resource Planning”- Pearson Education

OE-CS- AIML - 308	Stochastic Processes and Applications						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To provide an Understanding of the concepts of Random Process**						
	Course Outcomes						
CO 1	To demonstrate clear understanding of random variable and distribution.						
CO 2	To demonstrate operations on single random variable						
CO 3	To demonstrate operations on multiple random variable						
CO 4	To demonstrate random processes with its characteristics.						

Unit – I

THE RANDOM VARIABLE : Introduction, Review of Probability Theory, Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete, Continuous and Mixed Random Variables, Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional Distribution, Conditional Density, Properties.

Unit - II

OPERATION ON ONE RANDOM VARIABLE – EXPECTATIONS : Introduction, Expected Value of a Random Variable, Function of a Random Variable, Moments about the Origin, Central Moments, Variance and Skew, Chebychev's Inequality, Characteristic Function, Moment Generating Function, Transformations of a Random Variable: Monotonic Transformations for a Continuous Random Variable, Nonmonotonic Transformations of Continuous Random Variable.

Unit - III

MULTIPLE RANDOM VARIABLES : Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density, Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem: Unequal Distribution, Equal Distributions. OPERATIONS ON MULTIPLE RANDOM VARIABLES: Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case, N Random Variables case, Properties, Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.

Unit - IV

RANDOM PROCESSES – TEMPORAL CHARACTERISTICS: The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, Concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second-order and Wide-Sense Stationarity, Nth-order and Strict-Sense Stationarity, Time Averages and Ergodicity, Autocorrelation Function and its Properties, Cross-Correlation Function and its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process.

Suggested Books

- Probability, Random Variables & Random Signal Principles, Peyton Z. Peebles, TMH, 4th Edition, 2001.
- Probability, Random Variables and Stochastic Processes, Athanasios Papoulis and S.Unnikrisha, PHI, 4th Edition, 2002.
- Probability Theory and Stochastic Processes – B. Prabhakara Rao, BS Publications

- Probability and Random Processes with Applications to Signal Processing, Henry Stark and John W. Woods, Pearson Education, 3rd Edition.
- Schaum's Outline of Probability, Random Variables, and Random Processes.
- An Introduction to Random Signals and Communication Theory, B.P. Lathi, International Textbook, 1968.
- Random Process – Ludeman , John Wiley
- Probability Theory and Random Processes, P. Ramesh Babu, McGrawHill, 2015

PC-CS-AIML-312A	Applied Machine Learning Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3**
Purpose	To apply Machine Learning to complex real-world datasets and observe the findings.						
Course Outcomes (CO)							
CO1	To formulate a machine learning problem anddevelop a solution.						
CO2	To select an appropriate pattern analysis method for analyzing data.						
CO3	To apply machine learning techniques such as classification and feature selection to practical applications and detect patterns in the data.						
CO4	To develop an ANN network and analyze the data.						
CO5	To implement recent machine learning techniques, train models, conduct experiments, and develop real-world ML-based applications and products						

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

6. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

7. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

8. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

9. Implement the non-parametric Locally Weighted Regression algorithm to fit data points. Select appropriate data set for your experiment and draw graphs.

PC- CS-AIML-314A	Expert Systems Lab						
Lecture	**Tutorial**	**Practical**	**Credits**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	**To implement the concepts of intelligent agents, searching, knowledge and reasoning, planning, learning and expert systems.**						
Course Outcomes (CO)							
CO1	To implement about representing knowledge.						
CO2	To study the reasoning and decision making of some real life problems						
CO3	To construct plans and methods for generating knowledge.						
CO4	To study the concepts of expert systems.						

1. Study of Prolog Language.

2 Write simple fact for the statements using PROLOG.

3 Write predicates One converts centigrade temperatures to Fahrenheit, the other checks if a temperature is below freezing.

4 Write a program to solve the Monkey Banana problem.

5 WAP in turbo prolog for medical diagnosis and show the advantage and disadvantage of green and red cuts.

6 WAP to implement factorial, Fibonacci of a given number.

7 Write a program to solve 4-Queen problem.

8 Write a program to solve traveling salesman problem.

9 Write a program to solve water jug problem using LISP

10 Case study of standard AI programs, like, Mycin, and AI Shell.

PC- CS-AIML-318A	Software Testing Lab						
Lecture	**Tutorial**	**Practical**	**Credits**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	**To implement different techniques for testing software.**						
Course Outcomes (CO)							
CO1	To design and implement the test cases..						
CO2	Generating test cases for real life problems.						
CO3	To implement test management and software testing activities and V&V activities.						
CO4	To implement software testing in web and Object orient techniques.						

1. Decision table approach for solving triangle problem. Design and develop a program in a language of your choice to solve the triangle problem defined as follows : Accept three integers which are supposed to be the three sides of triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Derive test cases for your program based on decision-table approach, execute the test cases and discuss the results.

2. (Boundary value analysis program) .Design and develop a program in a language of your choice to solve the triangle problem defined as follows : Accept three integers which are supposed to be the three sides of triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Derive test cases for your program based on boundary value analysis, execute the test cases and discuss the result

3. (Equivalence class partitioning program) Design and develop a program in a language of your choice to solve the triangle problem defined as follows : Accept three integers which are supposed to be the three sides of triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Derive test cases for your program based on equivalence class partitioning , execute the test cases and discuss the results

4. Dataflow Testing for commission calculation.

5. (Boundary for Commission Problem) Design. develop, code and run the program in nay suitable language to solve the commission problem. Analyze it from the perspective of boundary value, derive test cases, execute these test cases and discuss the test results. Assumption price for lock=45.0, stock=30.0 and barrels=25.0 production limit could sell in a month 70 locks,80 stocks and 90 barrels commission on sales = 10 % <= 1000 and 15 % on 1000 to 1800 and 20 % on above 1800.

6. (Equivalence for Commission Problem) Design. develop, code and run the program in nay suitable language to solve the commission problem. Analyze it from the perspective of boundary value, derive test cases, execute these test cases and discuss the test results. Assumption price for lock=45.0, stock=30.0 and barrels=25.0 production limit could sell in a month 70 locks,80 stocks and 90 barrels commission on sales = 10 % <= 1000 and 15 % on 1000 to 1800 and 20 % on above 1800.

7. (Decision Test Case for Commission Problem) Design. develop, code and run the program in nay suitable language to solve the commission problem. Analyze it from the perspective of boundary value, derive test cases, execute these test cases and discuss the test results. Assumption price for lock=45.0, stock=30.0 and barrels=25.0 production limit could sell in a month 70 locks,80 stocks and 90 barrels commission on sales = 10 % <= 1000 and 15 % on 1000 to 1800 and 20 % on above 1800.

8. (Binary Search - Path Testing) Design, develop a code and run the program in any suitable language to implement the binary search algorithm. Determine the basis paths and using them derive different test cases execute these test cases and discuss the test results.

9. (Quick Sort-Path Testing) Design, develop ,code and run the program in any suitable language to implement the quicksort algorithm. Determine the basis paths and using them derive different test cases, execute these test cases and discuss the test results.

10. (Absolute Letter Grading Path Testing) Design, develop, code and run the program in any suitable language to implement an absolute letter grading procedure, making suitable assumptions. Determine the basis paths and using them derive different test cases, execute these test cases and discuss the test results.

11. Write the test cases for GMAIL.
12. Create and test plan document for any application (e.g. Library Management System)