IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Department of Computer Science & Engineering

Bachelor of Technology (B.Tech.)

Minor Certification in Computer Science & Information Technology

(To be offered to students of other departments excluding CSE)

S.No.	Subject Code	Semester	Subject Name	Contact Hours per week			Total Credits
				L	T	P	
1.	MICI-501	V	Data Structure and Algorithm	2	1	2	4
2.	MICI-601	VI	Foundation of AI & ML	2	1	2	4
3.	MICI-701	VII	Deep and Reinforcement learning	3	1	-	4
4.	MICI-801	VIII	*Block Chain Technology	2	-	2	3
			Total	9	3	6	15

1 Hr Lecture	1 Hr Tutorial	2 Hr Practical
1 Credit	1 Credit	1 Credit

Note: *VIII semester subject (Block Chain Technology or any other course equivalent to Block Chain Technology) can also be done from MOOC courses (NPTEL etc.) with minimum credit 3.

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MICI-501	**Data Structure & Algorithm**	**2L : 1T : 2P (5 hrs.)**	**4 credits**

Course Objective:

The objective of this course is to understand different types of data structures and algorithms used in program.

Course Contents: (46 hrs.)

Module 1: **(10 hrs.)**

Review of C programming language. Introduction to Data Structure: Concepts of Data and Information, Classification of Data structures, Abstract Data Types, Implementation aspects: Memory representation. Analysis of algorithm: Time Complexity and Space Complexity, Data structures operations and its cost estimation, Basic of Asymptotic notation. Introduction to linear data structures- Arrays, String, representation & Operations, Linked List: Representation of linked list in memory, different implementation of linked list. Circular linked list, doubly linked list, etc. Application of linked list: polynomial manipulation using linked list, etc.

Module 2: **(10 hrs.)**

Stacks: Stacks as ADT, Different implementation of stack, multiple stacks. Application of Stack: Conversion of infix to postfix notation using stack, evaluation of postfix expression, Recursion. Queues: Queues as ADT, Different implementation of queue, Circular queue, Concept of Dqueue and Priority Queue, Queue simulation, Application of queues.

Module 3: **(10 hrs.)**

Tree: Definitions - Height, depth, order, degree etc. Binary Search Tree - Operations, Traversal, Search, AVL Tree, Heap, Applications and comparison of various types of tree; Introduction to forest, multi-way Tree, B tree, B+ tree, B* tree and red-black tree.

Module 4: **(08 hrs.)**

Graphs: Introduction, Classification of graph: Directed and Undirected graphs, etc, Representation, Graph Traversal: Depth First Search (DFS), Breadth First Search (BFS), Graph algorithm: Minimum Spanning Tree (MST)- Kruskal, Prim's algorithms. Dijkstra's shortest path algorithm; Comparison between different graph algorithms. Application of graphs.

Module 5: **(08 hrs.)**

Sorting: Introduction, Classification of sorting method, Sort methods like: Bubble Sort, Quick sort. Selection sort, Heap sort, Insertion sort, Shell sort, Merge sort and Radix sort; comparison of various sorting techniques. Searching: Basic Search Techniques: Sequential search, Binary search, Comparison of search methods. Case Study: Application of various data structures in operating system, DBMS etc.

Course Outcome:

1. Understand basic data structures such as arrays, linked lists, stacks and queues
2. Introduce the concept of data structures through ADT including List, Stack, Queues.
3. Understand the basic operations of trees and its types.
4. Understand the basic concept of graph and its operations.
5. Demonstrate and implement searching sorting algorithms.

List of Text / Reference Books:

1. Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures" Computer Science Press.
2. Mark Allen Weiss "Algorithms, Data Structures, and Problem Solving with C++" , Pearson Education (US) 1996
3. R. G. Dromey "How to Solve it by Computer", 2nd Impression by, PHI
4. AM Tanenbaum, Y Langsam& MJ Augustein, "Data structure using C and C++", 2nd Ed., 2006 , Prentice Hall India.
5. Robert Kruse, Bruse Leung, "Data structures & Program Design in C", 2nd Ed., 1997, Pearson Education.
6. Aho, Hopcroft, Ullman, "Data Structures and Algorithms", Pearson Education.
7. Richard, GilbergBehrouz, Forouzan ,"Data structure – A Pseudocode Approach with C", 2nd Ed., Thomson press.

List of Experiments:

Write a program:

1. To perform insertion and deletion operations on array.
2. To perform multiplication operation on matrix
3. To calculate factorial of number using recursion.
4. To demonstrate static implementation of stack.
5. To demonstrate dynamic implementation of stack.
6. To demonstrate static implementation of Linear queue.
7. To demonstrate dynamic implementation of Linear queue.
8. To implement circular queue.
9. To implement single linked list.
10. To implement doubly linked list.
11. To implement binary search tree.
12. To perform BFS and DFS operations on graph.
13. To perform binary search operation.
14. To perform sorting operation using bubble sort.
15. To perform sorting operation using insertion sort.

MICI-601	Foundation of Artificial Intelligence and Machine Learning	2L: 1T: 2P (5 hrs.)	4 credits

Course Objective:

This course provides a concise introduction to the fundamental concepts in artificial intelligence and machine learning.

Course Contents :(40 hrs)

Module 1: **(10hrs.)**

Artificial Intelligence : Introduction, Various types of production systems, characteristics of production systems, breadth first search, depth first search techniques, other Search Techniques like hill Climbing, Best first Search, A* algorithm, AO* Algorithms and various types of control strategies. Knowledge representation issues, Prepositional and predicate logic, monotonic and on monotonic reasoning, forward Reasoning, backward reasoning.

Module 2: **(06 hrs.)**

Introduction: Basic dentitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation. Linear regression, Decision trees, over fitting.

Module 3: **(10 hrs.)**

Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM. Neural network: Perceptron, multilayer network, back-propagation, introduction to deep neural network. Convolution neural network, flattening, sub sampling, padding, stride, convolution layer, pooling layer, loss layer, dance layer 1x1 convolution, inception network, input channels, transfer learning, one shot learning, dimension reductions, implementation of CNN like tensor flow, keras etc.

Module 4: **(08 hrs.)**

Ensemble learning, Clustering: k-means, adaptive hierarchical clustering, and Gaussian mixture model. Application of machine learning in computer vision, speech processing, natural language processing etc, Case Study: ImageNet Competition

Module 5: **(06 hrs.)**

Instance based learning, Feature reduction, Collaborative filtering based recommendation. Probability and Bayes learning.

Course Outcome:

1. State the overview of the Artificial intelligence.
2. Explain the types of learning, linear regression and decision tree.
3. Discuss the various classification techniques and convolution neural network.
4. Explain the Ensemble learning and clustering techniques.
5. Discuss the recommendation system and Bayes learning.

List of Text / Reference Books:

1. Rich E and Knight K, "Artificial Intelligence", The McGraw- Hill,.3rd Edition,2008
2. Tom Mitchell , "Machine Learning", McGraw- Hill, First Edition, 1997.
3. Ethem Alpaydin , "Introduction to Machine Learning Edition" 2, MIT Press, Third Edition,2014.

List of Experiments:

1. Introduction to Artificial Intelligence
2. Introduction to Machine Learning
3. Plot neuron output over the range of inputs
4. Create Custom networks
5. Classification of linearly separable data with a perceptron
6. Classification of a 4-class problem with a perceptron
7. AI with Python – Supervised Learning: Classification
8. Support Vector Machines (SVM) Classifier.
9. Back propagation Algorithm
10. Case Study: Cancer Detection or Character Recognition or Iris Clustering

MICI-701	Deep & Reinforcement Learning	3L : 1T: 0P (4 hrs.)	4 credits

Course Objective:

The objective of this course is to learn designing and implementation of deep and reinforcement learning approaches using machine learning for solving real-life problems.

Course Contents: (40 hrs.)

Module 1: (06 hrs.)

History of Deep Learning, McCulloch Pitts Neuron, Thresholding Logic, Activation functions, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Eigenvalue Decomposition. Recurrent Neural Networks, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs, Encoder Decoder Models, Attention Mechanism, Attention overimages.

Module 2: (10 hrs.)

Autoencoders and relation to PCA, Regularization in autoencoders, Denoisingautoencoders, Sparse autoencoders, Contractive autoencoders, Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout, Batch Normalization, Instance Normalization, Group Normalization.

Module 3: (10 hrs.)

Greedy Layerwise Pre-training, Better activation functions, Better weight initialization methods, Learning Vectorial Representations Of Words, Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Recent Trends in Deep Learning Architectures.

Module 4: (08 hrs.)

Introduction to reinforcement learning(RL), Bandit algorithms – UCB, PAC,Median Elimination, Policy Gradient, Full RL & MDPs, Bellman Optimality, Dynamic Programming - Value iteration, Policy iteration, and Q-learning & Temporal Difference Methods, Temporal- Difference Learning, Eligibility Traces, Function Approximation, Least Squares Methods

Module 5: (06 hrs.)

Fitted Q, Deep Q-Learning , Advanced Q-learning algorithms , Learning policies by imitating optimal controllers , DQN & Policy Gradient, Policy Gradient Algorithms for Full RL, Hierarchical RL,POMDPs, Actor-Critic Method, Inverse reinforcement learning, Maximum Entropy Deep Inverse Reinforcement Learning, Generative Adversarial Imitation Learning, Recent Trends in RL Architectures.

Course Outcomes:

1. Describe in-depth about theories, models and algorithms in machine learning.
2. Compare and contrast different learning algorithms with parameters.
3. Examine the nature of a problem at hand and find the appropriate learning algorithms and it's parameters that can solve it efficiently enough.
4. Design and implement of deep and reinforcement learning approaches for solving real-life problems.

List of Text / Reference Books:

1. Deep Learning, An MIT Press book, Ian Goodfellow and YoshuaBengio and Aaron Courville
2. Pattern Classification- Richard O. Duda, Peter E. Hart, David G. Stork, John Wiley & Sons Inc.
3. Reinforcement Learning: An Introduction, Sutton and Barto, 2nd Edition.
4. Reinforcement Learning: State-of-the-Art, Marco Wiering and Martijn van Otterlo, Eds

MICI-801	Block Chain Technology	2L : 0T: 2P (4 hrs.)	3 credits

Course Objectives:

To understand the concept of Blockchain and its platforms- Bitcoin, Ethereum, Hyperledger and Multichain. The course provides an overview of the structure and mechanism of Blockchain.

Course Contents: (40 hrs.)

Module 1: **(06 hrs.)**

Introduction and crypto foundation: Elliptic curve Cryptography, ECDSA, Cryptographic hash function, SHA-256, Merkle trees, Cryptocurrencies.

Module 2: **(10 hrs.)**

Bitcoin, Bitcoin addresses, Bitcoin blockchain, block header, mining proof of work (PoW) algorithm, difficulty adjustment algorithm, mining pools, transactions, double spending attack, the 51% attacker, block format, transaction format, Smart contacts (escrow, micropayments, decentralized lotteries), payment channels.

Module 3: **(08 hrs.)**

Ethereum: Overview of differences between Ethereum and bitcoin, block form at, mining algorithm, proof-of-stake (PoS) algorithm, account management, contracts and transactions, Solidity language, decentralized application using Ethereum.

Module 4: **(08 hrs.)**

Smart Contracts Different Blockchains and Consensus mechanisms.

Module 5: **(08 hrs.)**

Blockchain and Security R3, CORDA and Hyperledger System architecture, ledger format, chain code, transaction flow and ordering, private channels, membership service providers, case studies

Course Outcomes:

After Completing the course student should be able to:
1.Understand blockchain architecture and requisite crypto foundation. 2.Understand various consensus protocol and their usage for their specific application.
3.Understand and Resolve security concern in blockchain.
4.Explore blockchain advances and upcoming platforms. 5.Learn to write smart contracts.
6.Understand use cases.

List of Text / Reference Books:

1. Mastering Bitcoin:Unblocking Digital Cryptocurrencies, by Andreas Antonopoulos.
2. Mastering Ethereum, Antonopoulos, Andreas M. and Wood, O'Reilly Media, Inc.,2018
3. An Introduction to Bitcoin, V. Saravanan, Lecture Notes.
4. Bitcoin and Cryptocurrencies Technologies: A Comprehensive Introduction, Arvind Narayanan,Princeton University Press (July 19,2016) ISBN-10:0691171696.

List of Experiments:

1. To Create a first block in blockchain.
2. To encrypt a block using Sha 256 Encryption Algorithm.
3. To Mine a Block in Blockchain.
4. To authenticate a mined block using consensus algorithm.
5. To implement proof of work.
6. To secure a block using encryption.
7. To create a simple cryptocurrency.
8. To write a smart contract in solidity.