

**Department of Computer Science and Technology**

**MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Information Brochure  
for M.Tech CSE and CS&IS Programme**



**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**

# Department of Computer Science and Engineering

## Brief About the Department

Department of Computer Science & Engineering came into existence in 1994. The first degree program offered by the Department was B.E. (Computer Engineering) in affiliation with the University of Rajasthan. The first batch graduated in 1998. Another degree programme B.E. (Information Technology) was initiated in 2001. In January 2004, first admissions to Ph.D. programme took place. In 2008, M.Tech. (Computer Science & Engineering) programme was initiated whereas, M.Tech. (Computer Science & Information Security) was started in 2016.

Faculty at Computer Science & Engineering believes in open interaction with students who are encouraged to participate in academic, research and extra-curricular activities. Students have never misplaced trust put in them by department and have done well in academic and industry alike.

## List of Programs offered by the Department:

Program	Title of the program
B.Tech	Computer Science and Engineering
M.Tech	Computer Science and Engineering
	Computer Science & Information Security
Ph.D.	Computer Science and Engineering

## Vision

To be a Centre of Excellence in Computer Science and Engineering domain and work with industry on cutting edge technology to address current and emerging challenges in global perspective for the development of society.

## Mission

To impart quality engineering education, enhance problem solving skills, foster research and innovation, encourage entrepreneurship and mold students of integrity and ethics to provide leadership with social sensitivity for the betterment of the country and humanity as a whole.

**Department of Computer Science and Engineering**

**Course Structure and Syllabus  
for M.Tech CSE and M.Tech CS&IS**

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

## DEPARTMENT of Computer Science and Engineering

### M.Tech. Computer Science and Engineering

#### Semester. I

S.No.	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1.	21CST501	Advanced Data Structures and Algorithms	PC	Theory	3	3	0	0
2.	21CST503	Parallel and Distributed Computing	PC	Theory	4	3	0	2
3.	21CST502	Advanced Databases	PC	Theory	3	3	0	0
4.	21CST813	Department Elective – 1	PE	Theory	3	3	0	0
5.	21CST814	Department Elective – 2	PE	Theory	3	3	0	0
6.	21CSP504	Programming Lab-1	PC	Lab	2	0	1	2
				Total	<b>18</b>			

#### Semester. II

S.No.	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1.	21CST507	Research Methodology	PC	Theory	2	2	0	0
2.	21CST842	Department Elective – 3	PE	Theory	3	3	0	0
3.	21CST843	Department Elective – 4	PE	Theory	3	3	0	0
4.	21CST844	Department Elective – 5	PE	Theory	3	3	0	0
5.	21CST845	Department Elective – 6	PE	Theory	3	3	0	0
6.	21CSP506	Programming Lab-2	PC	Lab	2	0	1	2
7.	21CSP505	Design Lab /Computing Tools	PC	Lab	2	0	1	2
				Total	<b>18</b>			

#### Semester. III

S.No.	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1.	21CSS603	Technical Documentation and Presentation	PC	---	2	0	1	2
2.	21CSP602	Literature Review	PC	---	2	0	1	2
3.	21CSD601	Dissertation – 1	PC	---	8	0	0	16
				Total	<b>12</b>			

#### Semester. IV

S.No.	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1.	21CSD604	Dissertation – 2	PC	---	12	0	0	24
				Total	<b>12</b>			

Total Credits: 60

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST501**

**Course Name : Advanced Data Structures and Algorithms**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type :Core**

**Prerequisites: None**

## **Course Contents**

RAM model – Notations, Recurrence analysis - Master's theorem and its proof - Amortized analysis, Recurrence equations. Advanced Data Structures: B-Trees, Binomial Heaps, Fibonacci Heaps, AVL trees, Red-black trees, B-trees, Splay trees, Interval trees; Disjoint set – union and path compression, Amortized analysis Greedy Algorithms: shortest distance, minimum spanning tree, interval scheduling, interval partitioning; Divide and Conquer: sorting, integer and polynomial multiplication; Dynamic programming: Longest common subsequence. Chain of matrix multiplication, sequence alignment, Bellman Ford Convex hull and Voronoi diagrams, line segments, Optimal polygon triangulation; Primality testing, Integer factorization; Graph algorithms: Matching and Flows; Parallel algorithms: Basic techniques for sorting, searching, merging. Intractability: Independent Set, Vertex Cover, Randomized algorithms, Probabilistic algorithms. Approximate Algorithms: Vertex-cover, set-covering problems, Travelling Salesman problem. Complexity classes - NP-Hard and NP-complete Problems - Cook's theorem NP completeness reductions, undecidability

## **Recommended Readings**

### **Text Books:-**

1. Cormen, Leiserson, Rivest: Introduction to Algorithms, Prentice Hall of India.
2. AhoA.V , J.D Ulman: Design and analysis of Algorithms, Addison Wesley
3. Brassard : Fundamental of Algorithmics, PHI.
4. Sara Baase: Computer Algorithms: Introduction to Design and Analysis, Pearson Education.
5. Papadimitriou, Steiglitz: Combinatorial Optimization: Algorithms and Complexity, PHI
6. Motwani and Raghavan: Randomized Algorithms, Cambridge University Press

7. Vazirani: Approximation Algorithms, Springer Verlag
8. Joseph Ja'Ja': Introduction to Parallel Algorithms, Addison-Wesley
9. Kleinberg, Tardos: Algorithm Design, Addison Wesley.
10. Dexter Kozen: The Design and Analysis of Algorithms. Springer, 1992
11. Sanjoy Dasgupta, Christos Papadimitriou, and Umesh Vazirani: Algorithms, McGraw Hill.
12. Robert Sedgewick and Kevin Wayne. Algorithms 4/e. Addison-Wesley.
13. Robert Tarjan: Data Structures and Network Algorithms, Society for Industrial and Applied Mathematics

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST503**

**Course Name : Parallel and Distributed Computing**

**Credits : 4    L - 3    T - 0    P - 2**

**Course Type :Core**

**Prerequisites:** Programming in C, Data Structures, Operating Systems, Computer Architecture and Organization, Computer Networks

## **Course Contents**

Parallel Computing, Sequential programs, Parallel Programs, Performance Metrics for Parallel Systems, Effect of Granularity on Performance, Scalability of Parallel Systems, Parallel Programming Platforms, Implicit Parallelism, SIMD & MIMD systems, Clusters, Single-Core and Multi-Core Processors, Physical Organization of Parallel Platforms, Cache Coherence, Interconnection Networks for Parallel Computers. Programming Using the Message-Passing Paradigm - MPI Principles of Message Passing Programming; Building blocks (Sending and Receiving Operations); Communication Library calls; Collective communication and Computation library calls, Programming Shared Address Space Platforms – OpenMP, Directive Parallel Programming; The OpenMP programming Model (Concurrent Tasks, Synchronization Constructs, Data Handling); Open libraries; OpenMP-Environment Variables; Parallel Programs, Matrix Computations, Matrix Vector Multiplication, Matrix- Matrix Multiplication, Solving system of Linear Equations; Parallel Implementation of Sparse Matrix Computations with Vector; Sorting algorithms, Issues in Sorting on Parallel Computers; Bubble Sort and its Variants, Quicksort; Parallelizing Quicksort; Sequential and Parallel Implementation of all-pairs of Shortest Paths Algorithms; Sequential & Parallel Search Algorithms; Depth-First Search Algorithms; Best-First Search Algorithms, Programming on Multi-Core Systems with GPU accelerators An Overview of Brief History of GPUs; An Overview of GPU Programming; An Overview of GPU Memory Hierarchy Features; An Overview of CUDA enabled NVIDIA GPUs, Introduction to CUDA C, Parallel Programming using OpenACC, CUDA APIs, CUDA Libraries for Numerical and Non-Numerical Computations; The OpenCL – Heterogeneous Programming; OpenCL Libraries, The OpenCL Memory Model, Execution Model; Platform and Devices; An Overview of OpenCL API; An Overview of MapReduce, An Overview of MapReduce Programming, An Overview of Hadoop Architecture /Execution (Master/slave, Namenode/Datanode); Hadoop Distributed File System (HDFS), An Overview of Hadoop Components, Hadoop – Control Flow

and Data Flow; An overview of Hive (Distributed Data Warehouse); Hbase (Distributed Column based database, PIG –(Data Flow Language);

### **Recommended Readings**

#### **Text Books:-**

1. AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar: Introduction to Parallel Computing, Second Edition Pearson Education – 2007
2. Peter Pacheco, An Introduction to Parallel Programming, Morgan Kaufman Publishers, Elsevier (2011)
3. Jason Sanders, Edward Kandrot, CUDA By Example – An Introduction to General-Purpose GPU Programming, Addison Wesley (2011)
4. RohitChnadra, Leonardo Dagum, Dave Kohr, DrorMaydan, Jeff McDonald, Ramesh Menon, Parallel Programming in OpenMP, Academic Press (2001)
5. Benedict R Gaster, Lee Howes, David R KaeliPerhaad Mistry Dana Schaa, (2011), Heterogeneous Computing with OpenCL McGraw-Hill, Inc. Newyork
6. Michael J. Quinn, Parallel Programming in C with MPI and OpenMP McGraw-Hill International Ed (2003)
7. Aru C Murthy, Vinod Kumar Vavilapalli, Doug Eadline, Joseph Niemiec, and Jeff Markham, Apache Hadoop YARN Moving beyond MapReduce and Batch Processing with Apache Hadoop 2, Addison Wesley, 2014

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST502**

**Course Name : Advances in Databases**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type :Core**

**Prerequisites:** Basic course in Database Management Systems

## **Course Contents**

Query Processing and Optimization – Implementation of Database operations, External Sorting, Size Estimations, Equivalence Rules, Heuristic-based Optimization, Materialized Views, Incremental View Maintenance. Transaction Processing - Concurrency Control Management, Serializability, Two-phase Lock Protocol, Deadlock Prevention and Detection, Timestamp-based Ordering Protocol, Log-based Recovery Management. Modern Database Systems - Database System Architectures, Distributed Database Systems, Parallel Databases, Times in Databases, Multimedia Databases Distributed Databases - Data Storage, Global Catalog, Distributed Transaction Processing, Two-Phase Commit Protocol, Distributed Query Processing.

## **Recommended Readings**

### **Text Books:-**

1. Silberschatz ,Korth, Sudarshan : Database System Concepts, McGraw Hill.
2. Elmasri and Navathe : Fundamentals of Database Systems, 3rd Edition, Addison

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CSP504**

**Course Name : Programming Lab – 1**

**Credits : 2    L - 0   T - 1   P - 2**

**Course Type :Core**

**Prerequisites:**

## **Course Contents**

Programming exercises and experiments in Algorithms Dynamic programming and Approximate Algorithms. Combinatorial algorithms, Randomized algorithms, Graph algorithms: Parallel algorithms: Basic techniques for sorting, searching, merging Programming exercises and experiments in Parallel and Distributed Computing. Parallel processing terminology, Pipelining Vs Data parallelism, multi-threaded architectures. Parallel reduction, Prefix sums, List ranking, preorder tree traversal, Merging two sorted lists Distributed and shared memory, Hadoop and MapReduce Programming exercises and experiments in Advanced Data structure and database. Advanced Lists, Segment Tree, Trie, Binary indexed tree. Self-Balancing BSTs, N-ary Tree. Disjoint Set, Suffix Array and Tree.

## **Recommended Readings**

### **Text Books:-**

1. Cormen, Leiserson, Rivest: Introduction to Algorithms, Prentice Hall of India
2. N. Deo: Graph Theory with Application to Engineering and Computer Science, Prentice-Hall
3. Ghosh, Moona and Gupta, Foundations of parallel processing, Narosa publishing.
4. Ed. Afonso Ferreira and Jose' D. P. Rolin, Parallel Algorithms for irregular problems - State of the art, Kluwer Academic Publishers

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST507**

**Course Name : Research Methodology**

**Credits : 2 L - 2 T - 0 P - 0**

**Course Type :Core**

**Prerequisites: None**

## **Course Contents**

Unit I: Data Structures and Algorithms: Review of Data Structures, and most commonly used algorithms in Computer Science and Engineering – Sorting, DFS/BFS, Pattern Searching. Unit II: Linear Algebra: Vectors - linear vector spaces, linear independence, norms and inner products, Basis and dimension, Matrices, Matrix operations, Inverse of a matrix Orthogonalization, Properties of determinants, Eigenvalues and eigenvectors, SVD and pseudo inverse, KL or hotelling transform. Unit III: Transforms Signals and representation, Convolution, Frequency Transforms, Properties of Fourier Transform, DFT, DCT and FFT, Introduction to wavelets, applications in Computer Science and Engineering Unit III: Probability and Statistics Statistics: Introduction to statistical analysis, hypothesis testing – null and alternate, statistical tests – chi-square, ANOVA, data validation Probability models and axioms, Bayes’ rule, discrete and continuous random variables, Probability distributions: normal distribution and properties, conditional, marginal and joint probability distribution, PRNG (pseudo random number generators) - randomness tests, introduction to information theory and cryptography: an Introduction Unit IV: Machine Learning: Linear and non-linear regression, supervised learning – neural network, binary decision diagram, SVM, k-NN, unsupervised learning – Clustering, Hidden Markov Models, Introduction to deep learning. Unit V: Case Studies in Research Domains of CSE.

## **Recommended Readings**

### **Text Books:-**

1. Gilbert Strang: Linear Algebra, MIT Cambridge Press.
2. Sheldon Ross: First Course in Probability, Pearson.
3. Mark Girolami, Simon Rogers: First Course In Machine Learning, CRC Press.

4. Anirban Das Gupta: Probability and Statistics for Machine Learning, Springer.
5. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, second ed, Springer
6. Ian Goodfellow: Deep learning, MIT Cambridge Press.

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CSP506**

**Course Name : Programming Lab – 2**

**Credits : 2    L - 1   T - 0   P - 3**

**Course Type : Elective**

**Prerequisites:** Programming Skills, Data Structures, Computer Networks

## **Course Contents**

1) Programming exercises and experiments in Operating Systems a. Kernel compilation and configuration, kernel modules, system calls and in-line assembly. b. Memory management, process management and scheduling c. Interrupts and interrupt handlers, synchronization etc. 2) Programming exercises and experiments in Advanced Database management systems. a. Cloud Databases: MongoDB/Cassandra etc. b. Transaction Processing: Practice on transaction processing 3) Programming assignments on NetSim and Libalium

## **Recommended Readings**

### **Text Books:-**

1. Stevens, W. R., “Unix Network Programming: Vol. II”, 2nd Ed., Pearson Education
2. Daniel P. Bovet, Marco Cesati, O’Reilly, “Understanding the Linux Kernel” Third Edition, 2005
3. Robert Love, “Linux Kernel Development”, Pearson Education, Third Edition, 2010
4. LAN Trainer user Manual.
5. Lee chao, “Cloud Database Development and Management”, CRC Publisher, 2013

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CSP505**

**Course Name : Design Lab / Computing Tools**

**Credits : 2    L - 0   T - 1   P - 2**

**Course Type :Core**

**Prerequisites:** Students must have prior programming experience in C/C++ or any language; mathematics through differential equations, and numerical analysis

### **Course Contents**

Operating Systems and Unix Environments: features of UNIX/Linux for scientific and technical computing; languages, compilers, debuggers, performance tools, make files, build systems, shell scripting, file management, source code control. Research Documentation and Simple Data Visualization: tools for generating research and code documentation: LATEX, Doxygen, plotting tools. Software Best Practices: software design cycle, regression testing, defensive programming, verification, code coverage Scientific Libraries: availability of common math libraries and usage for scientific computing.High performance Computing (HPC): Tool and techniques.

### **Recommended Readings**

#### **Text Books:-**

1. Eric S. Raymond, The Art of Unix Programming, Addison-Wesley 2003
2. Heister, T. and Rebholz, L. G., Introduction to Scientific Computing for Scientists and Engineers. De Gruyter Press, 2015.
3. John Levesque, High Performance Computing: Programming and Applications

## Electives Courses for PG-CSE

1.	<b>21CST802</b>	Advanced Computer Networks
2.	<b>21CST824</b>	Network on Chip
3.	<b>21CST803</b>	Advances in Compiler Design
4.	<b>21CST804</b>	Android Programming
5.	<b>21CST806</b>	Computer Vision
6.	<b>21CST807</b>	Cyber Physical Systems
7.	<b>21CST808</b>	Data Analytics
8.	<b>21CST809</b>	Data Compression
9.	<b>21CST810</b>	Data Mining
10.	<b>21CST812</b>	Deep Learning
11.	<b>21CST815</b>	Distributed Systems
12.	<b>21CST816</b>	E-Commerce
13.	<b>21CST817</b>	Hardware Software Codesign
14.	<b>21CST818</b>	Image Analysis
15.	<b>21CST819</b>	Information Retrieval
16.	<b>21CST820</b>	Internet of Things
17.	<b>21CST822</b>	Natural Language Processing
18.	<b>21CST823</b>	Nature Inspired Algorithms
19.	<b>21CST825</b>	Network Performance Modelling
20.	<b>21CST826</b>	Neural Networks
21.	<b>21CST827</b>	Parallel Processing & Algorithms
22.	<b>21CST828</b>	Parallelizing Compiler
23.	<b>21CST830</b>	Quantum Computing
24.	<b>21CST831</b>	Real Time Systems
25.	<b>21CST832</b>	Robotics and Control

26.	<b>21CST801</b>	5G Technology
27.	<b>21CST834</b>	Selected Topics in Operating System
28.	<b>21CST833</b>	Selected Topics in Computing
29.	<b>21CST835</b>	Social Media Mining
30.	<b>21CST836</b>	Social Network Analysis
31.	<b>21CST837</b>	Software Project Management
32.	<b>21CST838</b>	Software Testing and Validation
33.	<b>21CST840</b>	VLSI Algorithms
34.	<b>21CST841</b>	Wireless Sensor Networks
35.	<b>21CST821</b>	Machine Learning
36.	<b>21CST829</b>	Pattern Recognition
37.	<b>21CST805</b>	Big Data Analytics
38.	<b>21CST811</b>	Data Visualization
39.	<b>21CST839</b>	System on Chip
40.	<b>21CSL760</b>	Program Analysis

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST802**

**Course Name : Advanced Computer Networks**

**Credits : 3    L - 3   T - 0   P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Wireless networking: Bluetooth, 802.11 standards Information theory, bandwidth, multiple access  
Wireless Terahertz Networks 5G and 6G communication Intelligent Transportation Systems  
Emerging networking technologies: Host configuration and service discovery principles Future  
routing architectures IPv6 deployment scenarios and challenges, IPv6 transition/integration  
Advanced IP multicast, including IPv6 multicast and SSM Software-defined networking Delay-  
tolerant networking Future home network architectures IP network management and monitoring.  
Social Networks

## **Recommended Readings**

### **Text Books:-**

1. Tanenbaum A S and Wetherall D J (2010). Computer Networks.
2. Hagen S, (2006). IPv6 Essentials.
3. Recent publications on the relevant fields

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST824**

**Course Name : Network on Chip**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Computer Architecture, Logic System Design

## **Course Contents**

The Concept of route packet not wires for On-Chip Interconnection Networks, Topology and design architecture of Network-on-Chip, Area and power trade off NoC protocols, Routing and Flow Control mechanism, Verification of Communications in Networks-on-Chips. Application Mapping on Network-on-Chip, Resource Allocation for QoS On-Chip Communication, routing techniques in different 2D/ 3D NoC topology, performance evaluation in terms of throughput, latency, jitter. Signal Integrity and Reliability of Network-on-Chip, Testing of Network-on-Chip Architectures, Test and Fault Tolerance for NoC Infrastructures, Reconfigurable Network-on-Chip Design, Security in NoCs. Energy and Power estimation techniques Network-on-Chips

## **Recommended Readings**

### **Text Books:-**

1. Giovanni De Micheli, Luca Benini, Davide Bertozzi, Networks on Chips: Technology and Tools, Morgan Kaufmann, 2006.
2. Fayez Gebali, Haytham Elmiligi, Mohamed Watheq El-Kharashi, Networks on Chips: Theory and Practice, CRC Press, 2017.
3. Sudeep Pasricha, Nikil Dutt, On-Chip Communication Architectures: System on Chip Interconnect, Morgan Kaufmann, 2010.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST803**

**Course Name : Advances in Compiler Design**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Basic course in Compiler Design

## **Course Contents**

Modern Compiler Design – Structure of Compilers for Modern Programming Languages, Cross Compiler, Just-In-Time (JIT) and Adaptive Compilation, Runtime System Architectures. Parser Development - LR Parsers and LR Grammars – Design and Implementation, Parser and Ambiguity, Conflict Resolution, Lex and Yacc Tools. Optimizing Compiler - Control-flow Analysis, Control-flow Graphs, Basic Blocks, Data-flow Analysis Methods, Dependence Analysis, Global Optimizations, Loop Optimizations, Peephole Optimization and Optimal Code Generation, Data Dependence Analysis in Loops, Loop Scheduling.

## **Recommended Readings**

### **Text Books:-**

1. Aho, Lam, Sethi and Ullman: Compilers – Principles, Techniques and Tools, Pearson Education
2. Steven Muchnick : Advanced Compiler Design & Implementation, Morgan Kaufmann
3. Holub: Compiler Design in C, Prentice Hall India.
4. Keith Cooper and Linda Torczon : Engineering a Compiler, Morgan Kaufmann.

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST804**

**Course Name : Android Programming**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Basics: Review of Java Programming, Setting up and configuring Android Studio setup, Android Emulator Hello Android example, AndroidManifest.xml, R.java file, Activity, Fragment, Layout Manager - Relative Layout, Linear Layout, Table Layout, Grid Layout. Activity, Intent & Fragment: Activity Lifecycle, Activity Example, Intent – implicit and explicit, Intent filters, Fragment Lifecycle, Fragment Example, UI Widgets – buttons (toggle, switch, image), check box; Android Menu: Option Menu, Context Menu, Popup Menu; View. Android Service: lifecycle, example, Data Storage, Shared Preference, SQLite, Content Provider, Android Notification Adding functionality: Multimedia API, Speech API, telephony API, Location API Sensors: Sensor API, Working with WiFi, Working with Camera, Motion Sensor, Position Sensor; Android Graphics App development project.

## **Recommended Readings**

### **Text Books:-**

1. Official Android Website

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST806**

**Course Name : Computer Vision**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Introduction, Pixels and Filters, Image pyramids and Fourier transform, Hough transform, Edge detection, RANSAC, Feature detectors, Harris, Feature descriptors, Corner detection and matching, 2D transformations, Image homographs, Camera models, camera calibration, radiometry, color, shading, Bag of words, SIFT, SURF, Segmentation, Image indexing and search, Nearest Neighbor Match, Object Recognition, Face recognition, Differential motion: Optical flow, Feature Tracking & Motion Layers, Performance Evaluation

## **Recommended Readings**

### **Text Books:-**

1. Computer Vision: Algorithms and Applications, by Richard Szeliski
2. Computer Vision: A Modern Approach, by David Forsyth and Jean Ponce.
3. Computer Vision: Models, Learning, and Inference by, Simon J. D. Prince, Cambridge University Press.
4. Concise Computer Vision: An Introduction Into Theory and Algorithms, by Reinhard Klette, Springer

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST807**

**Course Name : Cyber Physical Systems**

**Credits : 3 L - 3 T - 0 P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Characteristics of Cyber-Physical Systems (CPS) Cyber-Physical Systems (CPS) in the real world, Basic principles of design and validation of CPS, Industry 4.0, AutoSAR, IIOT implications, Building Automation, Medical CPS CPS physical systems modeling and formalisms: CPS - Platform components - CPS HW platforms - Processors, Sensors, Actuators, CPS Network - WirelessHart, CAN, Automotive Ethernet, Scheduling Real Time CPS tasks. Principles of Dynamical Systems - Dynamical Systems and Stability, Controller Design Techniques and Performance under Packet drop and Noise CPS implementation issues - From features to automotive software components, Mapping software components to ECUs, CPS Performance Analysis - effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion, and building real-time networks for CPS Safe Reinforcement Learning: Robot motion control, Autonomous Vehicle control Gaussian Process Learning, Smart Grid Demand Response , Building Automation Secure Deployment of CPS: Secure Task mapping and Partitioning, State estimation for attack detection, Automotive Case study : Vehicle ABS hacking, Power Distribution Case study : Attacks on SmartGrids

## **Recommended Readings**

### **Text Books:-**

1. "Introduction to Embedded Systems – A Cyber–Physical Systems Approach" - E. A. Lee, SanjitSeshia
2. “Principles of Cyber-Physical Systems” - Rajeev Alur

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST808**

**Course Name : Data Analytics**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Fundamentals of Learning, Basic Programming skills,

## **Course Contents**

Introduction: Data Analytics, Big Data, Current landscape of perspectives - Skill sets needed; Statistical Inference-Populations and samples, Statistical modeling, Probability: Probability theory, conditional probability; probability distributions, fitting a model. Basic Analysis Techniques, Basic analysis techniques, Statistical hypothesis generation and testing, Chi-Square test, t-Test, Analysis of variance, Correlation analysis, Maximum likelihood test Exploratory Data Analysis (EDA) and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA - Philosophy of EDA - The Data Science Process, Data Visualization - Basic principles, ideas and tools for data visualization. Python for common data analysis: libraries like NumPy, Pandas matplotlib, and seaborn. Data wrangling and management: Accessing database, CSV, and JSON data, Data cleaning and transformations, APIs and other tools for scraping the Web, Data Management : knowledge of SQL such as MySQL, NoSQL like MongoDB, Cassandra etc. Python for Data cleaning and transformations using Pandas and Sklearn. Mining Social-Network Graphs - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighborhood properties in graphs.

## **Recommended Readings**

### **Text Books:-**

1. Trevor Hastie Robert Tibshirani Jerome Friedman, The Elements of Statistical Learning, Data Mining, Inference, and Prediction, 2nd Edn, Springer, 2014
2. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014.
3. Jiawei Han, Micheline Kamber and Jian Pei. Data Mining: Concepts and Techniques, Third Edition. ISBN 0123814790. 2011.

4. Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press. 2014.

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST809**

**Course Name : Data Compression**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Object Oriented Analysis and Design

## **Course Contents**

Introduction: Compression techniques, lossless compression, lossy compression, measures of performance, modeling and coding. Mathematical preliminaries - Overview, introduction to information theory, models, physical models, probability models, Markov models. Basic Coding Schemes: Statistical Methods - Shannon-Fano Algorithm, Huffman Algorithm, Adaptive Huffman Coding. Arithmetic Coding (Encoding, Decoding, Adaptive Coding). Dictionary Methods - LZ77, LZ78, LZW Algorithms. Case study of lossless compression standards. Lossless Compression standards: zip, gzip, bzip, unix compress, GIF, JBIG. Image and Video Compression: Discrete Cosine Transform, JPEG. Wavelet Methods - Discrete Wavelet Transform, JPEG 2000. Motion Compensation, Temporal and Spatial Prediction. MPEG and H.264. Audio Compression: Digital Audio, WAVE, FLAC, MPEG-1/2 Audio Layers.

## **Recommended Readings**

### **Text Books:-**

1. Khalid Sayood. 2012. Introduction to Data Compression (4th ed.). Elsevier
2. David Salomon, Giovanni Motta. 2010. Handbook of Data Compression. Springer, London

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST810**

**Course Name : Data Mining**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Introduction to data mining: Motivation and significance of data mining, data mining functionalities, interestingness measures, classification of data mining system, major issues in data mining. Data pre-processing: Need, data summarization, data cleaning, data integration and transformation, data reduction techniques – Singular Value Decomposition (SVD), Discrete Fourier Transform (DFT), Discrete Wavelet Transform ((DWT), data discretization and concept hierarchy generalization. Mining frequent patterns, associations and correlations: Basic concepts, efficient and scalable frequent itemset mining algorithms, mining various kinds of association rules – multilevel and multidimensional, association rule mining versus correlation analysis, constraint based association mining. Classification and prediction: Definition, decision tree induction, Bayesian classification, rule based classification, classification by backpropagation and support vector machines, associative classification, lazy learners, prediction, accuracy and error measures. Cluster analysis: Definition, clustering algorithms partitioning, hierarchical, density based, grid based and model based; Clustering high dimensional data, constraint based cluster analysis, outlier analysis – density based and distance based. Data mining on complex data and applications: Algorithms for mining of spatial data, multimedia data, text data; Data mining applications, social impacts of data mining, trends in data mining.

## **Recommended Readings**

### **Text Books:-**

1. Han, J. and Kamber, M., “Data Mining - Concepts and Techniques”, 3rd Ed., Morgan Kaufmann Series .

2. Ali, A. B. M. S. and Wasimi, S. A., “Data Mining - Methods and Techniques”, Cengage Publishers.
3. Tan, P.N., Steinbach, M. and Kumar, V., “Introduction to Data Mining”, Addison Wesley – Pearson
4. Pujari, A. K., “Data Mining Techniques”, 4th Ed., Sangam Books.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST812**

**Course Name : Deep Learning**

**Credits : 3    L - 3   T - 0   P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Course Overview: Introduction to Deep Learning and its Applications. Introduction to Statistical Learning: Multi-Layer Perceptron, Back Propagation, Linear Regression, etc. Convolutional Neural Networks: Convolution, pooling, Activation Functions, Back propagation of CNN, Weights as templates, Translation invariance, Training with shared parameters. CNN Architecture Design and Discussion: AlexNet, VGG, GoogLeNet, ResNet, Capsule Net, etc. Loss Functions and Optimization: Optimization, stochastic gradient descent, dropout, batch normalization, etc. Sequential Modelling: Recurrent and Recursive Nets, RNN, LSTM, GRU, Image captioning, visual question answering, etc. Visualization and Understanding: Visualizing intermediate features and outputs, Saliency maps, Visualizing neurons, Cam-Grad, etc. Generative Models: Variational Autoencoders, Generative Adversarial Networks like pix2pix, CycleGAN, etc. Deep Reinforcement Learning: Reinforcement Learning (RL) Background, Policy gradients, hard attention Q-Learning. Deep Learning Applications: Object Detection: RCNN, Fast RCNN, Faster RCNN, YOLO, Retina Net, SSD, etc. Semantic Segmentation: DeepLabV3, PSP Net, etc. Adversarial Attacks on CNN

## **Recommended Readings**

### **Text Books:-**

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, "Deep Learning," MIT Press.
2. Michael A. Nielsen, "Neural Networks and Deep Learning," Determination Press, 2015.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST815**

**Course Name : Distributed Systems**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Introduction to Distributed Systems, OS and Advanced OS, various distributed systems, Trends in Distributed System and challenges, Networking: network protocols, point-to-point communication. Introduction – Clocks, events and process states – Synchronizing physical clocks- Logical time and logical clocks – Global states, Limitations, Lamport’s logical clock, vector clock, causal ordering, global state, Cuts. Distributed Mutual Exclusion: Lamport, Recart-agrawala, and Maekawa’s algorithms; Suzuki-kasami broadcast algorithm, and Raymond’s tree based algorithm , Elections algorithms , Transactions and Concurrency Control– Transactions -Nested transactions – Locks – Optimistic concurrency control – Timestamp ordering – Atomic Commit Distributed transactions: two phase commit, three-phase commit, ACID/BASE models Techniques of Inter process Communication: the API for internet protocols – External data representation and Multicast communication, Sun RPC: programming and implementation, Network virtualization: Overlay networks. Case study: MPI Remote Method Invocation And Objects: Remote Invocation – Introduction – Request-reply protocols – Remote procedure call – Remote method invocation. Case study: Java RMI – Group communication – Publish-subscribe systems – Message queues – Shared memory approaches – Distributed objects – Case study: Enterprise Java Beans -from objects to components. Distributed Deadlock Detection: Resource Vs. Communication deadlock, Replication, Strategies to handle deadlock, Ho-Ramamoorthy, Path-Pushing, Edge-Chasing, Diffusion Computation-based algorithms. Agreement Protocols: System model, Classification of agreement problems, Solutions to Byzantine Agreement (BA) problems. Distributed Scheduling: Issues in Load Distribution, Components of a load distribution algorithm, Load Distribution Algorithms, V-system, Sprite, and Condor. Network file systems: design, NFS, AFS (scale), DFS & CIFS (cache control), CODA (redundancy) Google File System (GFS), Hadoop Distributed File System (HDFS) Distributed Shared Memory: Algorithms for implementing DSMs, Memory Coherence, and Coherence Protocols, IVY Process Management: Process Migration: Features,

Mechanism – Threads: Models, Issues, Implementation. Resource Management: Introduction-Features of Scheduling Algorithms –Task Assignment Approach – Load Balancing Approach – Load Sharing Approach Recovery: Classification of failures, Synchronous and Asynchronous Check pointing and Recovery. Fault Tolerance: Commit Protocols, Voting Protocols, Failure Resilient Processes. Protection and Security: Access Matrix Model, Implementation of access matrix, Unix, and Amoeba. Case study-Distributed systems

### **Recommended Readings**

#### **Text Books:-**

1. Andrew S. Tanenbaum, Maarten Van Steen, “Distributed Systems Principles and Paradigm,” 2nd Edition, Pearson
2. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair “Distributed Systems-Concepts and Design,” 5th Edition, Pearson
3. M. Singhal& N. Shivaratri, “Advanced Concepts in Operating Systems: Distributed, Database and Multiprocessor Operating Systems”, Tata McGraw Hill, 2015
4. John Bloomer, “Power Programming with RPC,” O’Reilly & Associates, Inc
5. Advanced Programming in the Unix Environment by W. Richard Stevens, Addison-Wesley,
6. Liu M.L., “Distributed Computing, Principles and Applications”, Pearson Education,
7. Distributed Systems - An Algorithmic approach by Sukumar Ghosh

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST816**

**Course Name : E-Commerce**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** knowledge of Digital Market, Basics of Computer Network and security

## **Course Contents**

Introduction: Definition of Electronic Commerce, technology and prospects, incentives for engaging in electronic commerce, needs of E-Commerce, E-Commerce Infrastructure, advantages and disadvantages, Impact of E-commerce on business, E-Commerce Models. Network Infrastructure for E- Commerce. Internet and Intranet based E-commerce: Issues, problems and prospects, Network Infrastructure, Network Access Equipments, Broadband telecommunication. Mobile Commerce: Introduction, Wireless Application Protocol, WAP technology, Mobile Information device. Web Security: Security Issues on web, Importance of Firewall, components of Firewall, Transaction security, Emerging client server, Security Threats, Network Security, Factors to consider in Firewall design, Limitation of Firewalls. Encryption: Encryption techniques, Symmetric Encryption: Keys and data encryption standard, Triple encryption, Secret key encryption; Asymmetric encryption: public and private pair key encryption, Digital Signatures, Virtual Private Network. Customer Service Expectations of the E-commerce Experience, Electronic Payments: Overview, The SET protocol, Payment: Smart card, credit card, magnetic strip card, E-Checks, Credit/Debit card based EPS, online Banking. EDI Application in business, E- Commerce Law, Forms of Agreement, Govt. policies and Agenda

## **Recommended Readings**

### **Text Books:-**

1. Turban, "Electronic Commerce 2004: A Managerial Perspective", Pearson Education
2. Pete Lohsin , John Vacca "Electronic Commerce", New Age International
3. Bajaj and Nag, "E-Commerce the cutting edge of Business", TMH 6
4. Laudon, "E-Commerce: Business, Technology, Society", Pearson Education

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST817**

**Course Name : Hardware Software Codesign**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Logic System Design/ Digital Logic Design

## **Course Contents**

Codesign overview, device Modeling and methodologies of system design, Hardware software partitioning and scheduling, Co simulation, synthesis and verifications, Architecture, Interface and reconfiguration, System on chip, Application specific processors (DSP), Codesign tools and case studies

## **Recommended Readings**

### **Text Books:-**

1. A Practical Introduction to Hardware/Software Codesign, Patrick Schaumont, Springer, 2009, ISBN 978-1-4419-5999-7
2. Specification and Design of Embedded Systems Daniel D. Gajski, Frank Vahid, S. Narayan, & J. Gong, Prentice Hall, 1994
3. Hardware / Software Co-Design: Principles and Practice, JStunstrup and Wayne Wolf, Prentice Hall, 1994.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST818**

**Course Name : Image Analysis**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Image Preliminaries & Image Processing: Overview, Computer imaging systems, Human visual system, image model, etc. Geometric transformations: Translation, rotation, scaling and shearing. Frequency transformation: Discrete Fourier transform (DFT), fast Fourier transform (FFT), short-time Fourier transform (STFT), Multi-resolution Expansions: Wavelet Transforms in 1-D and 2-D. The Fast Wavelet Transform Wavelet Packets Transform. Feature Extraction and Dimension Reduction Color, Texture, Shape and structure Features in spatial and frequency domains, Corner Detection, Hough Transform, Principal Component Analysis, Linear Discriminant Analysis, Feature Reduction in Input and Feature Spaces. Image Segmentation. Gray-level thresholding, Supervised vs. Unsupervised thresholding, Binarization using Otsu's method, Locally adaptive thresholding, Color-based segmentation, Region oriented segmentation, Use of motion in segmentation, Spatial techniques, Frequency domain techniques. Features Based Image Matching: Scale Space Image Processing, Different Feature descriptors: Key Point Detection, SIFT descriptor SURF descriptor Bag of Visual Words approach, Geometric consistency check, Vocabulary tree Panoramic Imaging, Template Matching, Mono Panorama, Stereo Panorama.

## **Recommended Readings**

### **Text Books:-**

1. J G Proakis and D G Manolakis, "Digital Signal Processing," Pearson, Fourth edition
2. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Prentice Hall, 3rd Edition, 2007.
3. Bishop, Pattern Recognition and Machine Learning
4. Duda, Pattern Classification

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST819**

**Course Name : Information Retrieval**

**Credits : 3    L - 3   T - 0   P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Introduction to Information Retrieval: The nature of unstructured and semi-structured text. Inverted index and Boolean queries. Text Indexing, Storage and Compression: Text encoding: tokenization, stemming, stop words, phrases, index optimization. Index compression: lexicon compression and postings, lists compression. Gap encoding, gamma codes, Zipf's Law. Index construction. Postings size estimation, merge sort, dynamic indexing, positional indexes, n-gram indexes, real-world issues. Retrieval Models: Boolean, vector space, TFIDF, Okapi, probabilistic, language modeling, latent semantic indexing. Vector space scoring. The cosine measure. Efficiency considerations. Document length normalization. Relevance feedback and query expansion. Rocchio. Performance Evaluation: Evaluating search engines. User happiness, precision, recall, F-measure. Creating test collections: kappa measure, interjudge agreement. Text Categorization and Filtering: Introduction to text classification. Naive Bayes models. Spam filtering. Vector space classification using hyperplanes; centroids; k Nearest Neighbors. Support vector machine classifiers. Kernel functions. Boosting. Text Clustering: Clustering versus classification. Partitioning methods. k-means clustering. Mixture of Gaussians model. Hierarchical agglomerative clustering. Clustering terms using documents. Advanced Topics: Summarization, Topic detection and tracking, Personalization, Question answering, Cross language information retrieval. Web Information Retrieval: Hypertext, web crawling, search engines, ranking, link analysis, PageRank, HITS, XML and Semantic web.

## **Recommended Readings**

### **Text Books:-**

1. Manning, Raghavan and Schutze, Introduction to Information Retrieval, Cambridge University Press.
2. Baeza-Yates and Ribeiro-Neto, Modern Information Retrieval, Addison-Wesley.

3. SoumenChakrabarti, Mining the Web, Morgan-Kaufmann
4. David A. Groosman, Information Retrieval, Algorithm and Heuristics, Springer

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST820**

**Course Name : Internet of Things**

**Credits : 3    L - 3   T - 0   P - 0**

**Course Type : Elective**

**Prerequisites:** Networks, Wireless Communication

## **Course Contents**

Introduction: Internet of Things and Connected Products, IoT paradigm, Smart objects, Goal orientation, Convergence of technologies; Business Aspects of the Internet of Things. Internet and “Things”: Layers, Protocols, Packets, Services, Performance parameters of a packet network and applications: Web, Peer-to-peer, Sensor networks, and Multimedia. Hardware and Software: Hardware components, Microcontrollers and Software; Operating Systems. Protocols and Platforms -IoT Communication Protocols, Transport Protocols, Application Protocols; Cloud computing for IoT. Services and Attributes: Data creation, Data gathering and Data dependency; Robustness, Scaling, Privacy, Security, Trust. Designing & Developing IoT applications: Introduction, IoT Design Methodology, Python Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/ Time Operations, Classes, Python Packages Application: Implications for the society, IoT case study.

## **Recommended Readings**

### **Text Books:-**

1. The Internet of Things: Key Applications and Protocols, David Boswarthick, Olivier Hersent, and Omar Elloumi, Wiley
2. Building the Internet of Things with IPv6 and MIPv6, Daniel Minoli, Wiley.
3. Latest research articles

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST822**

**Course Name : Natural Language Processing**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Data structures and algorithms, and strong programming skills

## **Course Contents**

Introduction to NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field. N-gram Language Models. The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. Part Of Speech Tagging and Sequence Labeling Lexical syntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training). Neural Networks and LSTM Introduction to perceptron and backpropagation, LSTM Recurrent Neural Networks Syntactic parsing Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs. Neural shift-reduce dependency parsing Semantic Analysis Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labeling and Semantic Parsing. Information Extraction (IE) Named entity recognition and relation extraction. IE using sequence labeling. Machine Translation (MT) Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars. Advanced Language Processing Advance language modeling (including LDA), other applications like summarization, question answering

## **Recommended Readings**

### **Text Books:-**

1. Speech and Language Processing: An Introduction to Natural Language

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST823**

**Course Name : Nature Inspired Algorithms**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Programming languages, Data structures and Algorithms

## **Course Contents**

Introduction to Algorithms, Optimization, Search for optimality, computational intelligence, Nature Inspired solutions and characteristic, Nature inspired Metaheuristics and its brief history, Analysis of Optimization Algorithms, Nature Inspired Algorithms, parameter Tuning and control Constrained and unconstrained optimizations, Random Walks and Optimizations, evolutionary strategies and Evolutionary Algorithms (EA), Simulated Annealing (SA) Algorithm and its behavior, Genetic Algorithms(GA)- genetic operator, parameters, fitness functions, genetic programming and convergence analysis, GA variants, Differential Evolution (DE), various Applications. Swarm Intelligence optimization, Particle Swarm Optimization(PSO) Algorithm, Ant Colony Optimization (ACO) Algorithms, Artificial Bee Colony (ABC) optimization algorithms, Cuckoo Search (CS) Algorithms, Intelligent Water Drop Algorithm (IWD), Bat Algorithms(BA), Firefly Algorithms(FA) Framework for self-tuning algorithms, Dealing with constraints, constraints handling, fitness functions, multi-objective optimization techniques and its applications, Hybrid algorithms, Ways to Hybridize

## **Recommended Readings**

### **Text Books:-**

1. Nature-Inspired Optimization Algorithms – by Xin-She Yang (Author), June 30, 2016
2. Mathematical Foundations of Nature-Inspired Algorithms, Xin-She Yang, Xing-Shi He, Springer; 1st ed. 2019 edition
3. Nature-Inspired Metaheuristic Algorithms: Second Edition, Xin-She Yang, Luniver Press

4. Introduction to Evolutionary Computing, A. E Eiben and J. E. Smith, Second Printing, Springer, 2007
5. Evolutionary Algorithms in Engineering Applications, Editors: Dipankar Dasgupta and Zbigniew Michalewicz, Springer-Verlag, 1997
6. D. E. Goldberg, Genetic Algorithms in search, Optimization and Machine Learning, Pearson India ,
7. Optimization Techniques and Applications with Examples By Xin-She Yan, wiley publisher

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST825**

**Course Name : Network Performance Modelling**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Introduction to Network Modeling: Network modeling, Computer Network as a discrete event system, Modeling and measurement tools, Network performance metrics – first order and second order metrics, Network capacity, Difference between throughput and capacity Network Calculus: Models for data flows, arrival curves and service curves, Greedy shapers, Basic min-plus and max-plus calculus, min-plus and max-plus systems, Optimal smoothing, FIFO systems and aggregate scheduling, Time varying shapers, Systems with losses, Case studies – (1) Analyzing spanning tree based data forwarding using network calculus, (2) Bound on loss rate Stochastic Scheduling and Resource Allocation: Stochastic scheduling, dynamic resource allocation, Dynamic programming models for stochastic scheduling, Queuing networks – open loop and closed loop networks, Jackson networks, Network fairness – proportional and max-min fairness, Markov process and its application for analyzing network resource allocation and fairness, available bandwidth estimation, Case studies – (1) TCP/IP flow and congestion control, (2) Modeling dynamic routing and scheduling as a queuing network problem, (3) Analysis of IEEE 802.11 channel access using two dimensional Markov process. Network Games: Introduction to game theory, Zero sum games, Nash equilibrium, Pareto optimality, Cooperative and Non-cooperative games, General network games – resource sharing games, routing games, congestion games, Mechanism design, Case studies – (1) Selfish routing in networks and price of anarchy, (2) Oblivious routing, (3) Network resource allocation games Protocol Analysis: Modeling discrete event system using petri-nets, basics of petri nets, stochastic petri nets, queuing petri nets, properties of petri nets, structural analysis of petri nets, Petri net modeling tools – simQPN, Case studies – (1) Wireless channel model using stochastic petri net, (2) Data center network throughput analysis using queuing Petri Nets

## **Recommended Readings**

**Text Books:-**

1. "Routing, Flow, and Capacity Design in Communication and Computer Networks", Michał Pióro, Deepankar Medhi, ISBN: 0125571895, Publisher: Morgan Kaufmann
2. The Network Calculus Book by Jean-Yves Le Boudec and Patrick Thiran is available for free download: [http://icalwww.epfl.ch/PS\\_files/NetCal.htm](http://icalwww.epfl.ch/PS_files/NetCal.htm)
3. Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach" Morgan Kaufman Publishers
4. Dimitri P. Bertsekas and Robert G. Gallager, "Data Networks": Materials are available at <http://web.mit.edu/dimitrib/www/datanets.html>
5. "Network Optimization: Continuous and Discrete Models", D. Bertsekas
6. Research Publications - will be discussed and distributed time to time

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST826**

**Course Name : Neural Networks**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Basic understanding of probability and statistics, linear algebra and calculus. A basic knowledge of programming (preferably Python) is essential.

## **Course Contents**

Introduction to Neural Architecture, McCulloch-Pitts networks, Learning Rules, Perceptrons, Regression and least mean square algorithm, Multilayer perceptrons, Back propagation: generalized delta rule, limitations, modifications – momentum, variable learning rate, conjugate gradient. Radial-basis function networks, Support vector Machines, Unsupervised learning and self-organization, Boltzmann machines and deep networks, Convolutional networks, Recurrent networks, Associative Memories, Adaptive Resonance Theory, Applications of Neural Networks.

## **Recommended Readings**

### **Text Books:-**

1. Simon Haykin: Neural Networks: A Comprehensive Foundation, Pearson

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST827**

**Course Name : Parallel Processing & Algorithms**

**Credits : 3    L - 3   T - 0   P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Introduction to parallel computing. Parallel processing terminology, Pipelining Vs Data parallelism, Control parallelism, Scalability, Control parallel approach, Data parallel approach, Data parallel approach with I/O. The PRAM Shared-Memory Model, Distributed-Memory or Graph Models, Circuit Model and Physical Realizations PRAM and Basic Algorithms, PRAM Submodels and Assumptions, Data Broadcasting, Semigroup or Fan-In Computation, Parallel reduction, Prefix sums, List ranking, Preorder tree traversal, Merging two sorted lists, Graph coloring, Reducing the number of processors, Problems defying fast solutions on PRAMS. Thread and process level parallel architectures: MIMD, multi-threaded architectures. Distributed and shared memory MIMD architectures. Dynamic interconnection networks. Mapping and scheduling: Mapping data to processors on processor arrays and multicomputers, Dynamic Load Balancing on multicomputers, Static scheduling on UMA multiprocessors, Deadlock. Parallel programming and parallel algorithms: Programming models, parallel programming on multiprocessors and multicomputers. Parallel algorithm structure, analyzing parallel algorithm. Elementary parallel algorithms, Matrix algorithms, sorting, Graph algorithms. Parallel Algorithm Complexity, Asymptotic Complexity, Algorithm Optimality and Efficiency, Complexity Classes, Parallelizable Tasks and the NC Class, Parallel Programming Paradigms, Solving Recurrences Sorting and Selection Network: Design of Sorting Networks, Batchier Sorting Networks, Mesh-Base Architectures: Sorting on a 2D Mesh or Torus, Routing on a 2D Mesh or Torus, Numerical 2D Mesh Algorithms, Low-Diameter Architectures: Hypercubes and Their Algorithms, Sorting and Routing on Hypercubes

## **Recommended Readings**

### **Text Books:-**

1. J. Jaja, An Introduction to Parallel Algorithms, Addison Wesley, 1992.

2. F. T. Leighton, Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes, Morgan Kaufmann Publishers, San Mateo, California, 1992
3. Behrooz Parhami, Introduction to Parallel Processing, Algorithms and Architecture, Kluwer Academic Publishers, 2002ed

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST828**

**Course Name : Parallelizing Compiler**

**Credits : 3    L - 3   T - 0   P - 0**

**Course Type : Elective**

**Prerequisites:** Basic course in Compiler Design

## **Course Contents**

Introduction – Compilation for parallel machines and automatic detection of parallelism, structure of a parallelizing compiler. Dependence Theory and Practice - Types of dependences, data and control dependencies, dependence analysis, direction vectors, loop carried and loop independent dependences, tests for data dependence and their applicability, construction of data dependence and control dependence graphs. Parallel Code Generation - Automatic extraction of parallelism, representation of iteration spaces of nested loops, loop based transformations such as loop distribution, loop coalescing, loop interchange and cycle shrinking transformation. Interprocedural Analysis and Optimization - aliasing information, summary data flow analysis, interprocedural constant propagation, interprocedural data dependence analysis and parallelization of call statements.

## **Recommended Readings**

### **Text Books:-**

1. Randy Allen, Ken Kennedy: Optimizing compilers for modern architectures. Morgan Kaufmann
2. Steven Muchnick : Advanced Compiler Design & Implementation, Morgan Kaufmann.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST830**

**Course Name :Quantum Computing**

**Credits : 3    L - 3   T - 0   P - 0**

**Course Type :Elective**

**Prerequisites: None**

## **Course Contents**

Introduction to quantum computing, Relevant Linear algebra for quantum computing, Postulates of quantum mechanics, Classical computing, Quantum circuits, Quantum Fourier Transform Quantum search algorithms, Physical realization of quantum computers. Quantum noise, Quantum operations, quantum information and quantum channel

## **Recommended Readings**

### **Text Books:-**

1. Pittenger A. O., An Introduction to Quantum Computing Algorithms
2. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.
3. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST831**

**Course Name : Real Time Systems**

**Credits : 3    L - 3   T - 0   P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Introduction : Definition, Typical Real Time Applications; Digital Control, High Level Controls, Signal Processing etc., Release Times, Deadlines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models for Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency. (7 hours) Real Time Scheduling: Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Slack-Time-First (LST) Algorithms, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clock Driven Systems. (8 hours) Resources Access Control: Effect of Resource Contention and Resource Access Control (RAC), Non-preemptive Critical Sections, Basic Priority-Inheritance and Priority-Ceiling Protocols, Stack Based Priority-Ceiling Protocol, Use of Priority-Ceiling Protocol in Dynamic Priority Systems, Preemption Ceiling Protocol, Access Control in Multiple-Unit Resources, Controlling Concurrent Accesses to Data Objects. (8 hours) Multiprocessor System Environment : Multiprocessor and Distributed System Model, Multiprocessor Priority-Ceiling Protocol, Schedulability of Fixed-Priority End-to-End Periodic Tasks, Scheduling Algorithms for End-to-End Periodic Tasks, End-to-End Tasks in Heterogeneous Systems, Predictability and Validation of Dynamic Multiprocessor Systems, Scheduling of Tasks with Temporal Distance Constraints. (9 hours) Real Time Communication : Model of Real Time Communication, Soft and Hard RTCommunication systems , Priority-Based Service and Weighted Round-Robin Service Disciplines for Switched Networks, Medium Access Control Protocols for Broadcast Networks, Internet and Resource Reservation Protocols, Real Time Protocols, Communication in Multicomputer System. An Overview of Real Time Operating Systems and Databases: Features of RTOS, UNIX as RTOS, POSIX Issues, Temporal Consistency, Concurrency Control. (8 hours)

## **Recommended Readings**

### **Text Books:-**

1. Real Time Systems: Theory and Practice – Mall Rajib, Pearson Education, 2009
2. Real-Time Systems: Scheduling, Analysis, and Verification – Albert M. K. Cheng, Wiley, 2002.
3. H. Kopetz, "Real time systems: Design Principles for distributed embedded applications", Springer Publications, 2011.
4. Douglass, Real Time UML: Advances in the UML for Real-Time Systems, 3/e, Addison-Wesley, 2004.
5. Awad, Kuusela & Ziegler, Object-Oriented Technology for Real Time Systems: A Practical Approach Using OMT and Fusion, 1/e, Pearson Education, 1996.
6. Ward & Mellor, Structured Development for Real-Time Systems, Vol. III: Implementation Modeling Techniques, Prentice Hall, 1986.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST832**

**Course Name : Robotics and Control**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Introduction to robotics-origin of automation, Classification of robots, Rotations and translation of vectors, Transformations and Euler angle representations, Homogeneous transformations, Problems, Trajectory planning, Actuators, Velocity and position sensors. Range, proximity, touch sensors, Control of Robot Manipulators: PD control, Nonlinear Control, Stability, Lyapunov's Direct Method, Adaptive Control, Robot Vision, Image segmentation, Template matching, Polyhedral objects, Shape analysis, Grasping and industrial automation

## **Recommended Readings**

### **Text Books:-**

1. M. Spong, S. Hutchinson, and M. Vidyasagar, Robot Modeling and Control Wiley (2006)
2. Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, "Industrial Robotics, Technology programming and Applications",
3. Craig. J. J. "Introduction to Robotics- mechanics and control", Addison- Wesley, 1999
4. Nagrath Gopal "Control Systems Engineering -Principles and Design" New Age Publishers
5. K. Ogata, "Modern control engineering", Pearson 2002.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST801**

**Course Name : 5G TECHNOLOGY**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Introduction and Key Specs of 5G Technologies, Opportunities and Challenges in mmWave MIMO Communication, Channel Models for mmWave MIMO Systems, Hybrid Signal Processing for mmWave MIMO, Digital and Analog Beamforming, Hybrid RF/ BB Precoder and Combiner Design for mmWave MIMO, Hybrid Transceiver Architectures for mmWave MIMO, Sparse Signal Processing and Channel Estimation for mmWave MIMO, Optimal Design of Beams and Sensing Matrix for Channel Estimation. Overview of Sub 6GHz Multiple Antenna, MIMO and MU-MIMO Technologies, Signal Processing for MIMO Systems, Optimal Power Allocation and Precoding for MIMO, Introduction to 5G Massive MIMO Systems, Key Features of Massive MIMO and Advantages over Point-to-Point and MU-MIMO, Signal Processing Operations for Massive MIMO in UL and DL, Massive MIMO Channel Model– Large/ Small Scale Fading, Properties of Random Vectors and Massive MIMO Analysis, Analysis of Spectral Efficiency in Massive MIMO Systems and Power Scaling, Pilot Design and Channel Estimation in Massive MIMO Systems Transmitter and Receiver Schemes with Imperfect CSI, Spectral Efficiency Analysis of Massive MIMO with Imperfect CSI, Power Scaling in Massive MIMO with Imperfect CSI and Comparison with Perfect CSI, Multi-Cell Massive MIMO Model, Channel Estimation with Pilot Reuse and Pilot Contamination. New Modulation Schemes for 5G- Spatial Modulation (SM), Space Shift Keying (SSK) and Optimal Receiver, Generalized Spatial Modulation (GSM), Spectral Efficiency Comparison of GSM with Conventional V-BLAST. Introduction to Non-Orthogonal Multiple Access (NOMA) Technology, Efficiency of NOMA wrto Conventional Orthogonal Multiple Access (OMA), Fixed NOMA Protocol for UL/ DL – Performance Analysis, Ordered NOMA Protocol and Performance Analysis, Comparison with Fixed NOMA, Optimal Power Allocation for NOMA Systems Overview of Multicarrier Modulation , Introduction to OFDM and MIMO OFDM Transceiver Design, Motivation for Filter Band Multi Carrier (FBMC) Technology in 5G, System Model for FBMC and Signal Processing, Offset QAM (OQAM)

Modulation and Transceiver Design, MIMO-FBMC System – Transmit/ Receive Signal Processing, Introduction to Full-Duplex Technology, Key Features and Advantages of Full Duplex Systems, Linear/ Non-Linear Self-Interference and Analog, Digital Cancellation Stages Introduction to 5G New Radio (NR) Standard, Introduction to 5G NB-IoT Technology, Overview of LTE- Cat M1 and Cat NB 1 Standards/ Systems 5G advanced concepts : Softwareization, virtualization, NFV, VNFV, 5G Slicing and etc Machine Type Communication(MTC) : Use cases and categorization, MTC Requirements, Fundamental techniques for MTC, Massive MTC, Ultra-reliable low-latency MTC, D2D Communication: from 4G to 5G, Radio resource management for mobile broadband D2D, Multi-hop D2D, communications for proximity and emergency services, Multi-operator D2D communication. 5G Radio Access Technologies: Access design principles for multi-user communications, Multi-carrier with filtering, Non-orthogonal schemes for efficient multiple access, Radio access for dense deployments, Radio access for V2X communication, Radio access for massive machine-type communication.

### **Recommended Readings**

#### **Text Books:-**

1. Asif Osseiran, Jose F.Monserrat and Patrick Marsch, “5G Mobile and Wireless Communications Technology”, Cambridge University Press, 2016.
2. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, Wiley, 2015
3. Patrick Marsch, Omer Bulakci, Olav Queseth and Mauro Boldi, “5G System Design – Architectural and Functional Considerations and Long Term Research”, Wiley, 2018

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST834**

**Course Name : Selected Topics in Operating System**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: Operating Systems**

## **Course Contents**

Introduction: Introduction and Background, Power of abstractions, Hardware resources, OS Functionalities, Managing the CPU and Memory. OS-Structure: Commercial OS, Monolithic structure, DOS like-structures. SPIN Approach to extensibility, Logical Protection Domains, Customized OS, Mechanism for events. Exokernel and MicroKernel: Approach to extensibility, Default core services in Exokernel, Secure Binding, Memory Management, L3 MicroKernel Approach, Potentials for Performance Loss, Strikes against Microkernel, Address Space Switches, Thread switches and IPC. Virtualization: Introduction, Platform Virtualization, Hypervisors, Full Virtualization, Para Virtualization. Memory Virtualization: Memory Subsystem recall, Shadow page table. VM oblivious page sharing, Memory Allocation Policies. CPU Virtualization and Device Virtualization: Control and Data transfer in Action, Disk IO Virtualization Protection & Security: Potential Security violations, External versus Internal Security, Policies and Mechanisms, Protection Domain, Design Principles for Secure Systems, Access Matrix Model & its Implementation., Case Studies: Unix Operating system, Hydra Kernel, Amoeba, Andrew.

## **Recommended Readings**

### **Text Books:-**

1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating System Concepts, 9th Edition, Wiley
2. Virtualization Essentials by Matthew Portnoy, Second Edition
3. Advanced Concepts In Operating Systems by Singhal, Tata McGraw-Hill Education
4. Daniel Bovet and Marco Cesati, Understanding the Linux Kernel, 3rd Edition, O'Reilly Media, 2008.
5. <https://in.udacity.com/course/advanced-operating-systems--ud189/>

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST833**

**Course Name : Selected Topics in Computing**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Programming in C / Python, Operating Systems, Database Management Systems, Computer Networks, Computer Architecture

## **Course Contents**

Topics will be announced by the Course Instructor at the beginning of the course depending on the emerging and evolving architectures. However, a sample list of topics are given for 2020-21 as below: Cluster and Grid Computing, Cloud Computing Big Data Analytics, Data Science, Data Lakes Internet of Things, 5G and beyond Software Defined Networks, Network Function Virtualization Quantum Computing, Block Chain

## **Recommended Readings**

### **Text Books:-**

1. Request for Comments, Red Books, White Papers
2. Research Papers on various aspects as decided by the Instructor
3. Lecture Notes of the Instructor
4. William Stallings, Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud, Addison-Wesley Professional, 2016
5. Kai Hwang, Min Chen, Big-Data Analytics for Cloud, IoT and Cognitive Computing, Wiley-Blackwell, 2017

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST835**

**Course Name : Social Media Mining**

**Credits : 3    L - 3   T - 0   P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Online Social Networks (OSNs): Introduction - Types of social networks (e.g., Twitter, Facebook), Measurement and Collection of Social Network Data, Social Networks - Basic Structure and Measures, Basics of Text Processing over Social Data, Entity linking and entity resolution for Social data. Characteristics of OSNs: Information Diffusion, Experimental studies over OSNs, Sampling, Fundamentals of Social Data Analytics: Topic Models, Random Walks, Heterogeneous Information Networks Applied Social Data Analytics: Recommendation Systems, Community identification and link prediction. Advanced Topics: Online experiments for Computational Social Science, Big Data Sampling

## **Recommended Readings**

### **Text Books:-**

1. Matthew A. Russell. Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Google+, Github, and More, 2nd Edition, O'Reilly Media
2. Jennifer Golbeck, Analyzing the social web, Morgan Kaufmann
3. Charu Aggarwal (ed.), Social Network Data Analytics, Springer
4. Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, Social Media Mining An Introduction, Cambridge University Press

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST836**

**Course Name : Social Network Analysis**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Network Models: Properties of Real-World Networks: Degree Distribution, Clustering Coefficient, Average Path Length. Random Graphs , Small-World Model, Preferential Attachment Model, Modeling of Real-World Networks using Random Graphs, Small-World Model and Preferential Attachment Model Network Measures: Centrality: Degree Centrality, Eigenvector Centrality, Katz Centrality, PageRank, Centrality, Closeness Centrality, Group Centrality. Transitivity and Reciprocity, Balance and Status, Similarity: Structural Equivalence, Regular Equivalence. Community Analysis: Community Detection, Community Detection Algorithms: Member-Based Community Detection, Group-Based Community Detection. Community Evolution: How Networks Evolve, Community Detection in Evolving Networks. Community Evaluation: Evaluation with Ground Truth, Evaluation without Ground Truth . Recommendation: Classical Recommendation Algorithms: Content-Based Methods, Collaborative Filtering (CF), Extending Individual Recommendation to Groups of Individuals, Recommendation Using Social Context, Evaluating Recommendations: Evaluating Accuracy of Predictions, Evaluating Relevancy of Recommendations Graph Representation Learning, Knowledge Graphs and Meta Paths, Graph Convolutional Networks, Link Prediction, Influence Maximization & Outbreak Detection.

## **Recommended Readings**

### **Text Books:-**

1. Networks, Crowds, and Markets: Reasoning About a Highly Connected World by David Easley and Jon Kleinberg.
2. Networks: An introduction by Mark Newman.

3. The Development of Social Network Analysis” by Linton C Freeman

4. Zafarani, Reza, Mohammad Ali Abbasi, and Huan Liu. Social media mining: an introduction. Cambridge University Press

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST837**

**Course Name : Software Project Management**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Software Engineering, Computer Programming (C/Java/Python/C++), Microsoft Excel

## **Course Contents**

Software Project Concepts: Software Project Categorization, Stakeholders, Software project Activities, Practices & Standards, Selecting Process Models (Spiral, Incremental, Prototyping, RAD, Agile). Estimation & Evaluation techniques, Cost Benefit Analysis, Risk Analysis for Project Evaluation, Program management, Project effort and cost estimation; Basis of estimation, Estimation method categorization, SLOC, Function Point Analysis, COCOMO, Putnam's work. Estimation using FP. Project Planning: Stepwise planning, Activity based approach (WBS), Sequencing and Scheduling of Activities, Critical Path Method. Risk Analysis and Management: Risk Identification, Projection, Risk Identification, Projection, Risk Refinement, Risk Monitoring and Management Schedule and Cost Monitoring: Collecting Data & Reporting, Graphical Visualization techniques, Cost Monitoring, Earned Value analysis, Requirements management, Change Control. Contract Management: Types of Contracts, Stages in Contract Placement, Typical Terms of a Contract, Contract Management and Acceptance. Software Configuration Management (SCM), SCM Tools, Project Reviews Testing and Software Reliability, Metrics, ISO and CMMI, Project Scheduling & Tracking, Software Quality Assurance, Software Configuration Management

## **Recommended Readings**

### **Text Books:-**

1. Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management", 6th Edition, Tata McGraw Hill, 2017.
2. Pankaj Jalote, Software Project Management in Practice.
3. Roger S. Pressman, Software Engineering

4. Royce, "Software Project Management", Pearson Education, 1999.
5. Robert K. Wysocki, Effective Software Project Management, Wiley, 2009.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST838**

**Course Name : Software Testing and Validation**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Software engineering, basic computer programming skills

## **Course Contents**

Testing Environment and Test Processes: Software Testing Environment, Overview of Software Testing Process, Organizing for Testing, Developing the Test Plan, Verification Testing, Analyzing and Reporting Test Results, Acceptance Testing. Levels of Testing, Unit Testing, Integration Testing, Defect Bash Elimination. System Testing, Usability and Accessibility Testing, Configuration Testing, Compatibility Testing. Functional and Non-functional system testing, Compliance Testing, Load Testing, Performance Testing and Security Testing. Static and dynamic testing, Black-box or functional testing, Equivalence partitioning, BVA, structural, White box or glass box testing, Mutation Testing, Data flow testing. Test Automation: Software Testing Tools, Software Test Automation, Debugging, Case study.

## **Recommended Readings**

### **Text Books:-**

1. Srinivasan Desikan and Gopaldaswamy Ramesh, “Software Testing – Principles and Practices”, Pearson Education
2. A.P. Mathur, Foundations of Software Testing, Pearson publications
3. Naresh Chauhan , “Software Testing Principles and Practices ” Oxford University Press , New Delhi .
4. Ilene Burnstein, “ Practical Software Testing”, Springer International Edition.
5. Renu Rajani, Pradeep Oak, “Software Testing – Effective Methods, Tools and Techniques”, Tata McGraw Hill.
6. William Perry, “Effective Methods of Software Testing”, Third Edition, Wiley Publishing

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST840**

**Course Name : VLSI Algorithms**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Logic synthesis & verification: Introduction to combinational logic synthesis, Binary Decision Diagram, Hardware models for High-level synthesis. VLSI Algorithms Partitioning: Problem formulation, classification of partitioning algorithms, Group migration algorithms, simulated annealing & evolution, other partitioning algorithms. Placement, floor planning & pin assignment: Problem formulation, simulation base placement algorithms, other placement algorithms, constraint-based floorplanning, floor planning algorithms for mixed block & cell design. General & channel pin assignment. Global Routing: Problem formulation, classification of global routing algorithms, Maze routing algorithm, line probe algorithm, Steiner Tree based algorithms, ILP based approaches. Detailed routing: problem formulation, classification of routing algorithms, single layer routing algorithms, two-layer channel routing algorithms, three-layer channel routing algorithms, and switchbox routing algorithms. Over the cell routing & via minimization: two layers over the cell routers, constrained & unconstrained via minimization Compaction: problem formulation, one-dimensional compaction, two dimension-based compaction, hierarchical compaction.

## **Recommended Readings**

### **Text Books:-**

1. NaveedSherwani, "Algorithms for VLSI Physical Design Automation", 3rd Edition, 2005, Springer International Edition
2. S.H. Gerez, "Algorithms for VLSI Design Automation", 1999, WILEY Student Edition, John Wiley & Sons (Asia) Pvt. Ltd.
3. ChristophMeinel& Thorsten Theobold, "Algorithms and Data Structures for VLSI Design", KAP, 2002.
4. Rolf Drechsheler : "Evolutionary Algorithm for VLSI", Second edition

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST841**

**Course Name : Wireless Sensor Networks**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Introduction: Introduction to adhoc/sensor networks: Key definitions of adhoc/ sensor networks, unique constraints and challenges, advantages of adhoc/sensor network, driving applications, issues in adhoc wireless networks/sensor network, data dissemination and gathering, Historical Survey of Sensor Networks Basic Architectural Framework: Traditional layered stack, Cross-layer designs, Sensor network architecture, Physical Layer, Basic Components, Hardware Platforms: Motes, Sensor Devices, Types of Sensors, Sensor's Specification MAC Protocols : Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts - Contention Based protocols - Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol. Routing Protocols: Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols. Sensor network security: Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks. Programming in WSNs: Challenges and limitations of programming WSNs, Introduction to TinyOS, -Programming in Tiny OS using NesC, Emulator TOSSIM, Open research issues

## **Recommended Readings**

### **Text Books:-**

1. Feng Zhao, Leonidas Guibas, “ Wireless Sensor Network”, Elsevier, 1st Ed. 2004 (ISBN: 13-978-1-55860-914-3)
2. Kazem, Sohrawy, Daniel Minoli, Taieb Znati, “Wireless Sensor Network: Technology, Protocols and Application”, John Wiley and Sons 1st Ed., 2007 (ISBN: 978-0-471-74300-2).

3. Raghavendra, Cauligi S, Sivalingam, Krishna M., ZantiTaieb, "Wireless Sensor Network", Springer 1st Ed. 2004 (ISBN: 978-4020-7883-5).

4. E. H. Callaway, Jr. E. H. Callaway, Wireless Sensor Networks Architecture and Protocols:, CRC Press , 2009

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST821**

**Course Name : Machine Learning**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Basic understanding of probability and statistics, linear algebra and calculus. A basic knowledge of programming (preferably Python) is essential.

## **Course Contents**

Advanced linear Algebra (e.g., SVD). The learning problem – learning versus design, types of learning- supervised, unsupervised, reinforcement and other views of learning. Linear Modeling: A least squares approach, linear modeling, making predictions, vector/matrix notation, linear regression, nonlinear response from a linear model. Generalization and over-fitting. The Bayesian approach to machine learning: exact posterior, marginal likelihoods. Probability based learning: Bayes theorem, Bayesian prediction, conditional independence and factorization, the Naive Bayes model. Error based learning: simple linear regression, multi variable linear regression with gradient descent. Logistic regression – gradient descent, non linear transformations the Z space. Similarity based learning: nearest neighbor, k- nearest neighbors, efficient distance computations: the KD trees. Information based learning: learning and trees, Classification and regression trees. Ensemble methods, Boosting, Bagging, Random forests. Neural networks – the perceptron, Multilayer perceptron, activation functions, gradient descent, deriving back propagation. Multi-task and transfer learning, Deep-learning. Linear discriminant analysis (LDA), Principal component analysis (PCA). SVM- optimal separation, the margin and support vectors, a constrained optimization problem, kernels – polynomial, radial basis, sigmoid. Performance Measures and Evaluation – for categorical targets, prediction scores, multinomial targets, continuous targets. Clustering – the general problem, hierarchical and partitional clustering, K-means clustering.

## **Recommended Readings**

### **Text Books:-**

1. Learning from Data, Yaser S Abu-Mostafa, AML books
2. Machine learning, Marsland, CRC press

3. An Introduction to Machine Learning, KubatMiroslav, Springer

4. Fundamentals of Machine Learning for predictive data analytics, John D Kelleher, MIT Press

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST829**

**Course Name : Pattern Recognition**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** An undergraduate level understanding of probability, statistics and linear algebra is assumed. A basic knowledge of Python is essential.

## **Course Contents**

The classification process: features, training and learning, approaches to classification Non metric methods: Information, Entropy and Impurity, decision tree classifier- ID3, C4.5. Discriminant functions: linear discriminant functions, piece-wise linear discriminant functions, generalized discriminant functions. Statistical pattern recognition: measured data and measurement errors, probability theory, conditional probability and Bayes rule, Naive Bayes classifier, Continuous random variables, The multivariate Gaussian, Covariance matrix and Mahalanobis distance Parametric learning: Bayesian decision theory, discriminant functions and decision boundaries, MAP (Maximum A Posteriori Estimator) Non Parametric learning: Histogram estimator and Parzen windows, k-NN classification, Artificial Neural Networks, Kernel Machines, SVM. Feature extraction and selection: reducing dimensionality, feature selection- Inter/Intra class distance, Feature extraction: Principal component analysis, Linear discriminant analysis. Unsupervised learning: Clustering, K- Means clustering, Fuzzy c-Means clustering, (Agglomerative) Hierarchical clustering Estimating and Comparing Classifiers: No free lunch, Bias and variance trade-off, cross-validation and resampling methods, Measuring classifier performance, Comparing classifiers- ROC curves, McNemar's test, other statistical tests

## **Recommended Readings**

### **Text Books:-**

1. Pattern Classification, Duda Hart, Wiley
2. Pattern Recognition and Classification, Geoff Dougherty, Springer
3. Statistical Pattern Recognition, Andrew R Webb, Wiley
4. Pattern Recognition and Machine Learning, Christopher Bishop, Springer

5. Pattern Recognition and Image Analysis, Earl Gose, Johnsonbaugh, PHI

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST805**

**Course Name : Big Data Analytics**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Overview of Database Management Systems, Introduction to Big Data, Introduction to distributed file system, Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics. Apache Hadoop & Hadoop Eco-System, Moving Data in and out of Hadoop, Understanding inputs and outputs of MapReduce, Data Serialization. Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read, Name-Node, Secondary Name-Node, and Data-Node, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup, SSH & Hadoop Configuration– HDFS Administering, Monitoring & Maintenance. Pig, Pig Latin Language, Hive Introduction, Hive queries. Spark Introduction. Cassandra CQL query language and CQL data model: Key space, Table definition, Column, and Data Types. Mongo DB Cluster analysis, K-means algorithm, Naïve Bayes, Parallel k-means using Hadoop, parallel particle swarm algorithm using MapReduce, case studies on big data mining. Parallel swarm Intelligence.

## **Recommended Readings**

### **Text Books:-**

1. Dan Sulliva ,NoSQL for Mere Mortals 1st Edition., Pearson Publishers, 2014
2. Pramod J. Sadalage, Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence 1st Edition, Pearson Publishers,ISBN-13: 978-0321826626, 2017.
3. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy, Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies (The MIT Press)
4. John D. Kelleher, Brendan Tierney, Data Science (MIT Press Essential Knowledge series).

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST811**

**Course Name : Data Visualization**

**Credits : 3 L - 3 T - 0 P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Modern Visualisation tools and techniques, Create multiple versions of digital visualizations using various software packages; Identify appropriate data visualization techniques given particular requirements imposed by the data; Apply appropriate design principles in the creation of presentations and visualizations; Analyse, critique, and revise data visualizations Information overload and issues in decision making Design of visual encoding schemes to improve comprehension of data and their use in decision making Use of Tableau - Data visualization tool for data analysts, scientists, statisticians, etc. to visualize the data and get a clear opinion based on the data analysis, Comparing classifiers- ROC curves, McNemar's test, other statistical tests.

## **Recommended Readings**

### **Text Books:-**

1. A first course Sosulski, K. (2018). Data Visualization Made Simple: Insights into Becoming Visual. New York: Routledge.
2. The Visual Display of Quantitative Information (2nd Edition). E. Tufte. Graphics Press, 2001.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST839**

**Course Name : System on Chip**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Transaction-Level Modeling & Electronic System-Level Languages, Hardware Accelerators, Media Instructions, Co-processors, System-Level Design Methodology, High-Level Synthesis (C-to-RTL), Hardware Synthesis and Architecture Techniques Source-Level Optimizations. Scheduling Resource, Binding and Sharing.

## **Recommended Readings**

### **Text Books:-**

1. De Micheli, editor Special Issue on Hardware/Software Co-design Proceedings of IEEE, Vol 85, No. 3, March 1997
2. D. D. Gajski, F. Vahid, S. Narayan, J. Gong : Specification and Design of Embedded Systems, Prentice Hall, Englewood Cliffs, NJ, 1994
3. J. Staunstrup and W. Wolf, editors: Hardware/Software Co-Design: Principles and Practice Kluwer Academic Publishers, 1997
4. G. DeMicheli, R. Ernst, and W. Wolf, editors, Readings in Hardware/Software Co-Design, Academic Press, 2002.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CSL760**

**Course Name : Program Analysis**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Introduction to analysis tools: debugging, disassembly, emulators, virtualization Introduction: Program Representation, Syntactic Analysis, Program Semantics, Static and dynamic analysis, Syntactic Analysis, Dataflow Analysis and Abstract Interpretation, Interprocedural analysis, Context-sensitive, Pointer analysis, Call Graph Construction, slicing and profiling, Control Flow Analysis, Dynamic Analysis for Data Race Detection Model Checking, Symbolic execution, Program Repair, Hoare Logic, SMT solvers

## **Recommended Readings**

### **Text Books:-**

1. Pierce, Benjamin C. Types and Programming Languages. MIT Press, 2002.
2. Winskel, Glynn. The Formal Semantics of Programming Languages: An Introduction. MIT Press, 1993.
3. Nielson, Nielson, and Hankin. Principles of Program Analysis. Springer, 2010.
4. Baier, and Katoen. Principles of Model Checking. MIT Press, 2008.
5. Chlipala, Adam. Certified Programming with Dependent Types: A Pragmatic Introduction to the Coq Proof Assistant. MIT Press, 2013.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

## DEPARTMENT of Computer Science and Engineering M.Tech. Computer Science and Information Security

### Semester. I

S.No.	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1.	21CST523	Cryptography	PC	Theory	3	3	0	0
2	21CST521	Advanced Data Structures and Algorithms	PC	Theory	3	3	0	0
3.	21CST522	Computer and Network Security	PC	Theory	4	3	0	2
4.	21CST854	Department Elective – 1	PE	Theory	3	3	0	0
5.	21CST855	Department Elective – 2	PE	Theory	3	3	0	0
6.	21CSP524	Programming Lab-1	PC	Lab	2	0	1	2
				Total	<b>18</b>			

### Semester. II

S.No.	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1.	21CST526	Research Methodology	PC	Theory	2	2	0	0
2	21CST872	Department Elective – 3	PE	Theory	3	3	0	0
3.	21CST873	Department Elective – 4	PE	Theory	3	3	0	0
4.	21CST874	Department Elective – 5	PE	Theory	3	3	0	0
5.	21CST875	Department Elective – 6	PE	Theory	3	3	0	0
6.	21CSP525	Design Lab	PC	Lab	2	0	1	2
7.	21CSP527	Security Tools Lab	PC	Lab	2	0	1	2
				Total	<b>18</b>			

### Semester. III

S.No.	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1.	21CSS623	Technical Documentation and Presentation	PC	---	2	0	1	2
2	21CSP622	Literature Review	PC	---	2	0	1	2
3.	21CSD621	Dissertation – 1	PC	---	8	0	0	16
				Total	<b>12</b>			

### Semester. IV

S.No.	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1.	21CSD624	Dissertation – 2	PC	---	12	0	0	24
				Total	<b>12</b>			

Total Credits: 60

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST523**

**Course Name : Cryptography**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Core**

**Prerequisites: None**

## **Course Contents**

Number theory: Prime numbers, GCD, Euclidean Algorithm, Extended Euclidean Algorithm, Fermat's theorem, Euler's theorem, Chinese remainder theorem, Discrete logarithms, Primality testing algorithms, Probability, Bays Theorem. Introduction to Information security and cryptography, Basic terminology and concepts, Classical Cryptographic techniques and their cryptanalysis, Shannon perfect secrecy, One Time Pad, Pseudo random generators, Semantic security, indistinguishability based Security. Stream ciphers and RC4, Various types of attacks, Chosen-Plaintext Attack. Chosen-Ciphertext Attack etc. Block Ciphers: Data Encryption Standard (DES), Advanced Encryption Standard (AES), DES attacks, Modes of operations One-way function, trapdoor one-way function, Public key cryptography, RSA cryptosystem, Diffie-Hellman key exchange algorithm, ElGamal Cryptosystem Cryptographic hash functions, secure hash algorithm, Message authentication, digital signature, RSA digital signature.

## **Recommended Readings**

### **Text Books:-**

1. William Stallings, Cryptography and Network Security: Principles and Practice, Prentice Hall
2. Douglas R. Stinson, Cryptography: Theory and Practice, Chapman and Hall
3. J. Katz and Y. Lindell, Introduction to Modern Cryptography, CRC press
4. N. Koblitz, Number Theory and Cryptography, Springer, 2001

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST521**

**Course Name : Advanced Data Structures and Algorithms**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Core**

**Prerequisites: None**

## **Course Contents**

RAM model – Notations, Recurrence analysis - Master's theorem and its proof - Amortized analysis, Recurrence equations. Advanced Data Structures: B-Trees, Binomial Heaps, Fibonacci Heaps, AVL trees, Red-black trees, B-trees, Splay trees, Interval trees; Disjoint set – union and path compression, Amortized analysis. Greedy Algorithms: shortest distance, minimum spanning tree, interval scheduling, interval partitioning; Divide and Conquer: sorting, integer and polynomial multiplication; Dynamic programming: Longest common subsequence. Chain of matrix multiplication, sequence alignment, Bellman Ford. Convex hull and Voronoi diagrams, line segments, Optimal polygon triangulation; Primality testing, Integer factorization; Graph algorithms: Matching and Flows; Parallel algorithms: Basic techniques for sorting, searching, merging. Intractability: Independent Set, Vertex Cover Randomized algorithms, Probabilistic algorithms. Approximate Algorithms: Vertex-cover, set-covering problems, Travelling Salesman problem. N Complexity classes - NP-Hard and NP-complete Problems - Cook's theorem NP completeness reductions, undecidability.

## **Recommended Readings**

### **Text Books:-**

1. Cormen, Leiserson, Rivest: Introduction to Algorithms, Prentice Hall of India.
2. AhoA.V , J.D Ulman: Design and analysis of Algorithms, Addison Wesley
3. Brassard : Fundamental of Algorithmics, PHI
4. Sara Baase: Computer Algorithms: Introduction to Design and Analysis, Pearson Education.
5. Papadimitriou, Steiglitz: Combinatorial Optimization: Algorithms and Complexity, PHI.
6. Motwani and Raghavan: Randomized Algorithms, Cambridge University Press

7. Vazirani: Approximation Algorithms, Springer Verlag
8. Joseph Ja'Ja': Introduction to Parallel Algorithms, Addison-Wesley
9. Kleinberg, Tardos: Algorithm Design, Addison Wesley.
10. Dexter Kozen: The Design and Analysis of Algorithms. Springer, 1992.
11. Sanjoy Dasgupta, Christos Papadimitriou, and Umesh Vazirani: Algorithms, McGraw Hill.
12. Robert Sedgewick and Kevin Wayne. Algorithms 4/e. Addison-Wesley.
13. Robert Tarjan: Data Structures and Network Algorithms, Society for Industrial and Applied Mathematics.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST522**

**Course Name : Computer and Network Security**

**Credits : 4 L - 3 T - 0 P - 2**

**Course Type : Core**

**Prerequisites: None**

## **Course Contents**

Introduction (a) Security(b) Malware(c) OWASP top ten and other major security issues in the world(d) CVE and other information(e) Introduce various type of security areas Software and OS Security: Common Bugs, Buffer Overflow, Runtime Defences against memory safety vulnerabilities, program verification and other vulnerabilities, Principles in OS Security; Mechanisms for confining bad code, Mechanisms for confining bad code : isolation, sandboxing, SFI and Virtualization, Trusted Computing Network and Web Security: Secure web site design (SQL injection, XSS, etc.), Browser Security, Security problems in network protocols: TCP/IP, DDoS Attacks, Network worms and bot-nets: attacks and defences, DNS and BGP security, Network defence tools – Firewall and Intrusion Detection. Future Networks Security: Introduction - The Security in Existing wireless Networks, Upcoming wireless networks and challenges, Thwarting and malicious behaviour – Naming and addressing, security association and secure neighbour discovery, secure routing in multichip wireless networks and privacy protection. Mobile OS Security and Privacy: Android, IOS security challenges, processor security, privacy, anonymity and censorship and other security issues according to the current situations and future requirements

## **Recommended Readings**

### **Text Books:-**

1. Security in Computing (3rd edition)
2. Research publications on security

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CSP524**

**Course Name : Programming Lab 1**

**Credits : 2    L - 0   T - 1   P - 2**

**Course Type : Core**

**Prerequisites:** Programming skills required

## **Course Contents**

Programming exercises and experiments in Computer Networks and Security. a. Experiments on LAN Trainer Kit: Performance study of data link layer protocols, implementation and testing Network Layer routing protocols, understanding the steps involved in RC4 algorithm encryption b. Programming exercises using sockets c. Design and implementation of a Data Sniffer Programming exercises and experiments in Advanced Data Structures a. Primality testing b. Recursive algorithms c. Sorting algorithms d. Heaps, priority queues, and binary search trees e. Red-black trees f. Graph based algorithms g. String matching algorithms Programming on advanced data structures by choosing the right data representation formats based on the requirements of the problem and selecting the right algorithmic paradigm (such as greedy, dynamic programming, divide and conquer etc.). Implement the basic cryptographic algorithms: a. Euclidean and Extended Euclidean algorithm for finding the Greatest Common Divisor of two large integers. b. Chinese remainder theorem. c. Modular polynomial arithmetic d. Diffie-Hellman Key exchange protocol Implement the advanced cryptographic algorithms: Congruence of squares. Finding a congruence of squares modulo  $n$  to factor  $n$ . Construction of Finite Field of characteristic 2. Computations in elliptic curve over a finite field

## **Recommended Readings**

### **Text Books:-**

1. Menezes, P.C. van Oorschot, S.A. Vanstone: Handbook of Applied Cryptography: CRC Press, 1996.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms (3rd Edition)", T. Publisher: MIT Press.
3. Peter Brass, "Advanced Data Structures", Cambridge University Press, 2008.

4. Abhijit Das and C.E.VeniMadhavan, Public-key Cryptography: Theory and Practice, Pearson, 2009.Bottom of Form
5. Introduction to Modern Cryptography, Jonathan Katz and Yehuda Lindell.
6. LAN Trainer user Manual

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST526**

**Course Name : Research Methodology**

**Credits : 2    L - 2    T - 0    P - 0**

**Course Type : Core**

**Prerequisites: None**

## **Course Contents**

Unit I: Data Structures and Algorithms: Review of Data Structures, and most commonly used algorithms in Computer Science and Engineering – Sorting, DFS/BFS, and Pattern Searching. Unit II: Linear Algebra: Vectors - linear vector spaces, linear independence, norms and inner products, Basis and dimension, Matrices, Matrix operations, Inverse of a matrix Orthogonalization, Properties of determinants, Eigenvalues and eigenvectors, SVD and pseudo inverse, KL or hotelling transform. Unit III: Transforms Signals and representation, Convolution, Frequency Transforms, Properties of Fourier Transform, DFT, DCT and FFT, Introduction to wavelets, applications in Computer Science and Engineering Unit III: Probability and Statistics Statistics: Introduction to statistical analysis, hypothesis testing – null and alternate, statistical tests – chi-square, ANOVA, data validation Probability models and axioms, Bayes' rule, discrete and continuous random variables, Probability distributions: normal distribution and properties, conditional, marginal and joint probability distribution, PRNG (pseudo random number generators) - randomness tests, introduction to information theory and cryptography: an Introduction Unit IV: Machine Learning: Linear and non-linear regression, supervised learning – neural network, binary decision diagram, SVM, k-NN, unsupervised learning – Clustering, Hidden Markov Models, Introduction to deep learning. Unit V: Case Studies in Research Domains of CSE.

## **Recommended Readings**

### **Text Books:-**

1. Gilbert Strang: Linear Algebra, MIT Cambridge Press.
2. Sheldon Ross: First Course in Probability, Pearson.
3. Mark Girolami, Simon Rogers: First Course In Machine Learning, CRC Press.

4. Anirban Das Gupta: Probability and Statistics for Machine Learning, Springer.
5. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, second ed, Springer
6. Ian Goodfellow: Deep learning, MIT Cambridge Press.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CSP525**

**Course Name : Design Lab**

**Credits : 2    L - 0   T - 1   P - 2**

**Course Type : Core**

**Prerequisites:** Students must have prior programming experience in C/C++ or any language; mathematics through differential equations, and numerical analysis

## **Course Contents**

Operating Systems and Unix Environments: features of UNIX/Linux for scientific and technical computing; languages, compilers, debuggers, performance tools, make files, build systems, shell scripting, file management, source code control. Research Documentation and Simple Data Visualization: tools for generating research and code documentation: LATEX, Doxygen, plotting tools. Software Best Practices: software design cycle, regression testing, defensive programming, verification, code coverage Scientific Libraries: availability of common math libraries and usage for scientific computing. High performance Computing (HPC): Tool and techniques operating Systems and Unix Environments: features of UNIX/Linux for scientific and technical computing; languages, compilers, debuggers, performance tools, make files, build systems, shell scripting, file management, source code control. Research Documentation and Simple Data Visualization: tools for generating research and code documentation: LATEX, Doxygen, plotting tools. Software Best Practices: software design cycle, regression testing, defensive programming, verification, code coverage Scientific Libraries: availability of common math libraries and usage for scientific computing. High performance Computing (HPC): Tool and techniques.

## **Recommended Readings**

### **Text Books:-**

1. Eric S. Raymond, The Art of Unix Programming, Addison-Wesley 2003.
2. Heister, T. and Rebholz, L. G., Introduction to Scientific Computing for Scientists and Engineers. De Gruyter Press, 2015.
3. John Levesque, High Performance Computing: Programming and Applications

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CSP527**

**Course Name : Security Tools Lab**

**Credits : 2    L - 0   T - 1   P - 2**

**Course Type : Core**

**Prerequisites: NIL**

## **Course Contents**

Etherreal/ Wireshark real time network analyzer, packet sniffing techniques ,TCPDump, Safety control using Metasploit , Vulnerability assessment using Nessus tool, Intrusion detection using Snort, Wireless safety tools, Network tracking using Nagios, Kali Linux tools, Hardware and software security tools

## **Recommended Readings**

### **Text Books:-**

1. On line resources

### Electives Courses for CS-IS

1.	<b>21CST802</b>	Advanced Computer Networks
2.	<b>21CST804</b>	Android Programming
3.	<b>21CST848</b>	Biometrics
4.	<b>21CST850</b>	Cloud Security
5.	<b>21CST851</b>	Cyber Security
6.	<b>21CST852</b>	Data Compression
7.	<b>21CST853</b>	Deep Learning
8.	<b>21CST856</b>	Digital Forensics
9.	<b>21CST857</b>	Embedded System Security
10.	<b>21CST858</b>	Internet of Things
11.	<b>21CST871</b>	Wireless Security
12.	<b>21CST859</b>	Intrusion Detection
13.	<b>21CST861</b>	Nature Inspired Algorithms
14.	<b>21CST862</b>	Network Performance Modelling
15.	<b>21CST863</b>	Pattern Recognition
16.	<b>21CIL736</b>	Program Analysis
17.	<b>21CST864</b>	Public Key Infrastructure and Trust Management
18.	<b>21CST865</b>	Quantum Cryptography
19.	<b>21CST866</b>	Security Analysis of Protocols
20.	<b>21CST821</b>	Machine Learning
21.	<b>21CST867</b>	Selected Topics in Cryptography
22.	<b>21CST868</b>	Social Network Analysis
23.	<b>21CST869</b>	Software Testing and Validation
24.	<b>21CST870</b>	VLSI Algorithms
25.	<b>21CST849</b>	Blockchain Technologies

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST802**

**Course Name : Advanced Computer Networks**

**Credits : 3 L - 3 T - 0 P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Wireless networking: a. Bluetooth, 802.11 standards b. Information theory, bandwidth, multiple access c. Wireless Terahertz Networks d. 5G and 6G communication e. Intelligent Transportation Systems Emerging networking technologies: a. Host configuration and service discovery principles b. Future routing architectures c. IPv6 deployment scenarios and challenges, IPv6 transition/integration d. Advanced IP multicast, including IPv6 multicast and SSM e. Software-defined networking f. Delay-tolerant networking g. Future home network architectures h. IP network management and monitoring i. Social Networks

## **Recommended Readings**

### **Text Books:-**

1. Tanenbaum A S and Wetherall D J (2010). Computer Networks.
2. Hagen S, (2006). IPv6 Essentials.
3. Recent publications on the relevant fields

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST804**

**Course Name : Android Programming**

**Credits : 3    L - 3   T - 0   P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Basics: Review of Java Programming, Setting up and configuring Android Studio setup, Android Emulator Hello Android example, Android Manifest.xml, R.java file, Activity, Fragment, Layout Manager - Relative Layout, Linear Layout, Table Layout, Grid Layout Activity, Intent & Fragment: Activity Lifecycle, Activity Example, Intent – implicit and explicit, Intent filters, Fragment Lifecycle, Fragment Example, UI Widgets – buttons (toggle, switch, image), check box; Android Menu: Option Menu, Context Menu, Popup Menu; View Android Service: lifecycle, example, Data Storage, Shared Preference, SQLite, Content Provider, Android Notification Adding functionality: Multimedia API, Speech API, telephony API, Location API Sensors: Sensor API, Working with WiFi, Working with Camera, Motion Sensor, Position Sensor; Android Graphics App development project

## **Recommended Readings**

### **Text Books:-**

1. Official Android Website

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST848**

**Course Name : Biometrics**

**Credits : 3 L - 3 T - 0 P - 0**

**Course Type : Elective**

**Prerequisites:** A basic knowledge of statistics, linear algebra, and programming is expected.

## **Course Contents**

Introduction: Person recognition, Biometric systems, Biometric functionalities, biometrics system errors, the design cycle of biometric systems. Fingerprint recognition: friction ridge patterns, fingerprint acquisition, feature extraction and matching, palm prints. Face recognition: image acquisitions, face detection, feature extraction and matching, handling pose, illumination and expression variations Iris recognition: image acquisition, Iris segmentation, Iris normalization, Iris encoding and matching, Iris quality assessment techniques Additional Biometric Traits: Ear, Gait, Hand geometry, Soft biometrics Multibiometrics: sources of multiple evidence, fusion levels: sensor, feature, score, rank and decision level fusion. Security of biometric systems: adversary attacks, attacks at user interface, attacks on biometric processing, attacks on template database.

## **Recommended Readings**

### **Text Books:-**

1. Introduction to Biometrics, Anil K Jain Arun Ross, Springer
2. The Science of Biometrics, Ravindra Das, Springer
3. Practical Biometrics, Julian Ashbourn, Springer

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST850**

**Course Name : Cloud Security**

**Credits : 3    L - 3   T - 0   P - 0**

**Course Type : Elective**

**Prerequisites:** Computer Networks, Operating System

## **Course Contents**

Introduction of Cloud Computing: Taxonomy and related technologies, Essential Characteristics, Service and Deployment Models. Virtualization: Types of Virtualization and Hypervisors, Virtualization at Storage, Compute and Network, Hypervisors (Types and Case studies), Virtual Machine Provisioning, Virtual Machine Migration. Architectures:Standards, Orchestration, Provisioning, Portability, Interoperability, Federated Cloud, Security: CIA Triad, Vulnerabilities in Cloud, Threats to Infrastructure, Data and Access Control;Identity Management; Multi Tenancy Issues; Attack taxonomy; Intrusion Detection, VM Specific attacks, VM Introspection, Management; Trusted Cloud Initiative of Cloud Security Alliance (CSA). Forensics: NIST Forensics Reference Architecture, Forensic Science Challenges, Architectural Issues, Evidence Collection and Analysis, Anti-Forensics, Incident Response, Standards and Framework

## **Recommended Readings**

### **Text Books:-**

1. K. Hwang, G. C. Fox, and J. Dongarra, Distributed and Cloud Computing, 1st ed.: Morgan Kaufmann, 2011
2. R. Buyya, J. Broberg, and A. M. Goscinski, Cloud Computing: Principles and Paradigms: Wiley-Blackwell, 2011
3. S. Dinkar and G. Manjunath, Moving to the Cloud: Developing Apps in the New World of Cloud Computing Syngress Media, U.S., 2012.
4. W. Stallings, Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud, 1st ed.: Addison-Wesley Professional, 2015.

5. T. Erl, Z. Mahmood, and R. Puttini, Cloud Computing: Concepts, Technology & Architecture: Prentice Hall/PearsonPTR, 2014.
6. R. L. Krutz and R. D. Vines, Cloud Security - A Comprehensive Guide to Secure Cloud Computing, Wiley Publishing, 2010
7. T. Mather, S. Kumaraswamy, and S. Latif, Cloud Security and Privacy - An Enterprise Perspective on Risks and Compliance, O Reilley Publishers, 2009.
8. V. (J. R.) Winkler, G. Speake, P. Foxhoven, Securing the Cloud: Cloud Computer Security Techniques and Tactics, Syngress, 2011.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST851**

**Course Name : Cyber Security**

**Credits : 3    L - 3   T - 0   P - 0**

**Course Type : Elective**

**Prerequisites: NIL**

## **Course Contents**

Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats, Need for a Comprehensive Cyber Security Policy. Cyber Security Safeguards (Overview): Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management. Network Security & Web Security: Security Issues in TCP/IP, which includes TCP, DNS, Routing (basic problems of security in TCP/IP, IPsec, BGP Security, DNS Cache poisoning, etc), Network Defense tools such as Firewalls, Filtering, DNSSec, NSec3, Distributed Firewalls, Web Application Security: Cross-Site Scripting Attacks, Cross-Site Request Forgery, SQL Injection Attacks Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation. Cyber Forensics: Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating Email header information, Tracing Internet access, Tracing memory in real-time. Security in Mobile Platforms: Android vs. iOS security model, threat models, information tracking, rootkits, Threats in mobile applications, analyzer for mobile apps to discover security vulnerabilities, Viruses, Spywares, and keyloggers and malware detection. Cyberspace and the Law

## **Recommended Readings**

### **Text Books:-**

1. Latest research papers, journals and articles

2. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and SunitBelapure.

3. Cybersecurity Essentials By Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short · 2018

4. Cybersecurity: Attack and Defense Strategies: Infrastructure Security with Red Team and Blue Team TacticsBook by ErdalOzkaya and Yuri Diogenes

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST852**

**Course Name : Data Compression**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Object Oriented Analysis and Design

## **Course Contents**

Introduction: Compression techniques, lossless compression, lossy compression, measures of performance, modeling and coding. Mathematical preliminaries - Overview, introduction to information theory, models, physical models, probability models, Markov models. Basic Coding Schemes: Statistical Methods - Shannon-Fano Algorithm, Huffman Algorithm, Adaptive Huffman Coding. Arithmetic Coding (Encoding, Decoding, Adaptive Coding). Dictionary Methods - LZ77, LZ78, LZW Algorithms. Case study of lossless compression standards. Lossless Compression standards: zip, gzip, bzip, unix compress, GIF, JBIG. Image and Video Compression: Discrete Cosine Transform, JPEG. Wavelet Methods - Discrete Wavelet Transform, JPEG 2000. Motion Compensation, Temporal and Spatial Prediction. MPEG and H.264. Audio Compression: Digital Audio, WAVE, FLAC, MPEG-1/2 Audio Layers.

## **Recommended Readings**

### **Text Books:-**

1. Khalid Sayood. 2012. Introduction to Data Compression (4th ed.). Elsevier.
2. David Salomon, Giovanni Motta. 2010. Handbook of Data Compression. Springer, London.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST853**

**Course Name : Deep Learning**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Course Overview: Introduction to Deep Learning and its Applications. Introduction to Statistical Learning: Multi-Layer Perceptron, Back Propagation, Linear Regression, etc. Convolutional Neural Networks: Convolution, pooling, Activation Functions, Back propagation of CNN, Weights as templates, Translation invariance, Training with shared parameters. CNN Architecture Design and Discussion: AlexNet, VGG, GoogLeNet, ResNet, Capsule Net, etc. Loss Functions and Optimization: Optimization, stochastic gradient descent, dropout, batch normalization, etc. Sequential Modelling: Recurrent and Recursive Nets, RNN, LSTM, GRU, Image captioning, visual question answering, etc. Visualization and Understanding: Visualizing intermediate features and outputs, Saliency maps, Visualizing neurons, Cam-Grad, etc. Generative Models: Variational Autoencoders, Generative Adversarial Networks like pix2pix, CycleGAN, etc. Deep Reinforcement Learning: Reinforcement Learning (RL) Background, Policy gradients, hard attention Q-Learning. Deep Learning Applications: Object Detection: RCNN, Fast RCNN, Faster RCNN, YOLO, Retina Net, SSD, etc., Semantic Segmentation: DeepLabV3, PSP Net, etc. Adversarial Attacks on CNN.

## **Recommended Readings**

### **Text Books:-**

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, "Deep Learning," MIT Press.
2. Michael A. Nielsen, "Neural Networks and Deep Learning," Determination Press, 2015.

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST856**

**Course Name : Digital Forensics**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Operating Systems, Computer Networks & Security

## **Course Contents**

File System Forensics: Duplicating hard disks for "dead analysis", reading hidden data on a disk's Host Protected Area (HPA), Direct versus BIOS access, dead versus live acquisition, Disk partitions - DOS, Apple, and GPT partitions, BSD disk labels, Sun Volume; multiple disk volumes - RAID and disk spanning; Analyzing FAT, NTFS, Ext2, Ext3, UFS1, and UFS2 file systems, Finding evidence: File metadata, recovery of deleted files, Using The Sleuth Kit (TSK), Autopsy Forensic Browser, and related open source tools Web Forensics: network-based evidence in Windows and Unix environments, Reconstructing Web browsing, email activity, Tracing domain name ownership and the source of e-mails System Forensics: Windows Registry changes, Duplicating and analyzing the contents of PDAs and flash memory devices Electronic document, computer image verification and authentication.

## **Recommended Readings**

### **Text Books:-**

1. Brian Carrier. File System Forensic Analysis, Addison Wesley.
2. Chris Prosise, Kevin Mandia. Incident Response and Computer Forensics, McGraw Hill. Course Technology.
3. Linda Volonino, Reynaldo Anzaldua, and Jana Godwin. Computer Forensics: Principles and Practices, Prentice Hall.
4. Keith J. Jones, Richard Bejtlich, and Curtis W. Rose. Real Digital Forensics: Computer Security and Incident Response, Addison Wesley.

5. Vacca, John R., Computer Forensics Computer Crime Scene Investigation, Charles River Media.

6. Nelson, Phillips, Enfinger, Steuart. Guide to computer Forensics and Investigation

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST857**

**Course Name : Embedded System Security**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Security Flaws and Attacks in Embedded systems: Code injection, Invasive and Non invasive physical and logical attacks Defenses Against Code Injection Attacks: Methods using Address Obfuscation and Software Encryption, Anomaly Detection. Safe Languages, Code Analyzers Compiler, Library, and Operating System Support for embedded systems. security, Control Flow Checking, IP Protection: Encryption of IP Cores, additive and Constraint-Based watermarking. Implementation of DES 3DES, AES, RC4, MD5, RSA algorithms

## **Recommended Readings**

**Text Books:-**

1. Security in Embedded Hardware

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST858**

**Course Name : Internet of Things**

**Credits : 3    L - 3   T - 0   P - 0**

**Course Type : Elective**

**Prerequisites:** Computer Networks, Wireless Communication

## **Course Contents**

Introduction: Internet of Things and Connected Products, IoT paradigm, Smart objects, Goal orientation, Convergence of technologies; Business Aspects of the Internet of Things. Internet and “Things”: Layers, Protocols, Packets, Services, Performance parameters of a packet network and applications: Web, Peer-to-peer, Sensor networks, and Multimedia. Hardware and Software: Hardware components, Microcontrollers and Software; Operating Systems. Protocols and Platforms -IoT Communication Protocols, Transport Protocols, Application Protocols; Cloud computing for IoT. Services and Attributes: Data creation, Data gathering and Data dependency; Robustness, Scaling, Privacy, Security, Trust. Designing & Developing IoT applications: Introduction, IoT Design Methodology, Python Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/ Time Operations, Classes, Python Packages Application: Implications for the society, IoT case study.

## **Recommended Readings**

### **Text Books:-**

1. The Internet of Things: Key Applications and Protocols, David Boswarthick, Olivier Hersent, and Omar Elloumi, Wiley
2. Building the Internet of Things with IPv6 and MIPv6, Daniel Minoli, Wiley.
3. Latest research articles

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST871**

**Course Name : Wireless Security**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Computer Networks

## **Course Contents**

Foundations of Wireless Security: Wireless as a necessity, advantages and disadvantages, information security and wireless LANs, wireless LAN standards and types, Wireless LAN vulnerabilities. Risks and Threats of Wireless: Social Engineering, phishing, search engine scanning, Denial-of-service, malicious code, War driving, rogue access points, RFID. Wireless Security Models: Wireless Security Basics, Equivalent Privacy Standard (WEP), Extensible Authentication Protocol (EAP), Wi-Fi Protected Access (WPA), WPA2, 802.11i, attacks on WEP, EAP, WPA, 802.11i. Designing a secure wireless network: Basic principles of security design-layering, limiting, diversity, obscurity, simplicity; network segmentation, hardware placement, wireless device security. Wireless security Policy: policy overview, risk assessment, designing security policy, impact analysis, wireless security policy areas, types of wireless security policies.

## **Recommended Readings**

### **Text Books:-**

1. Wireless Security Handbook, by Aaron E. Earle, Auerbach Publications
2. CWSP Guide to Wireless Security, by Mark Ciampa, 1st Edition.

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST859**

**Course Name : Intrusion Detection**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Introduction- Intrusion Detection System (IDS), Intrusion Prevention System (IPS), Unauthorized access – buffer overflow, packet fragmentation, out-of-spec packets Review of Network protocol – TCP/IP, Intrusion detection through tcpdump. IDS and IPS – Architecture and internals. Malicious and non-malicious traffic, IP headers, TCP, UDP and ICMP protocols and header formats, Header information to detect intrusion, logs and their analysis, IDS through reaction and response Intrusion analysis – data correlation, tools, SNORT- A case study.

## **Recommended Readings**

### **Text Books:-**

1. Matt Fearnow, Stephen Northcutt, Karen Frederick, and Mark Cooper. Intrusion Signatures and Analysis, SAMS.
2. Carl Endorf, Gene Schultz, Jim Mellander, Intrusion Detection and Prevention, McGraw Hill.
3. Paul E. Proctor. The Practical Intrusion Detection Handbook, Prentice Hall.
4. Stephen Northcutt and Judy Novak. Network Intrusion Detection, SAMS.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST861**

**Course Name : Nature Inspired Algorithms**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Data structures

## **Course Contents**

Introduction to Algorithms, Optimization, Search for optimality, computational intelligence, Nature Inspired solutions and characteristic, Nature inspired Metaheuristics and its brief history, Analysis of Optimization Algorithms, Nature Inspired Algorithms, parameter Tuning and control Constrained and unconstrained optimizations, Random Walks and Optimizations, evolutionary strategies and Evolutionary Algorithms (EA), Simulated Annealing (SA) Algorithm and its behavior, Genetic Algorithms(GA)- genetic operator, parameters, fitness functions, genetic programming and convergence analysis, GA variants, Differential Evolution (DE), various Applications. Swarm Intelligence optimization, Particle Swarm Optimization(PSO) Algorithm, Ant Colony Optimization (ACO) Algorithms, Artificial Bee Colony ACO) optimization algorithms, Cuckoo Search (CS) Algorithms, Intelligent Water Drop Algorithm (IWD), Bat Algorithms(BA), Firefly Algorithms(FA) Framework for self-tuning algorithms, Dealing with constraints, constraints handling, fitness functions ,multi-objective optimization techniques and its applications , Hybrid algorithms, Ways to Hybridize.

## **Recommended Readings**

### **Text Books:-**

1. Nature-Inspired Optimization Algorithms – by Xin-She Yang (Author), June 30, 2016
2. Mathematical Foundations of Nature-Inspired Algorithms, Xin-She Yang, Xing-Shi He, Springer; 1st ed. 2019 edition
3. Nature-Inspired Metaheuristic Algorithms: Second Edition, Xin-She Yang, Luniver Press
4. Introduction to Evolutionary Computing, A. E Eiben and J. E. Smith, Second Printing, Springer, 2007

5. Evolutionary Algorithms in Engineering Applications, Editors: Dipankar Dasgupta and Zbigniew Michalewicz, Springer-Verlag, 1997
6. D. E. Goldberg, Genetic Algorithms in search, Optimization and Machine Learning, Pearson India
7. Optimization Techniques and Applications with Examples By Xin-She Yan, Wiley publisher

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST862**

**Course Name : Network Performance Modelling**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Introduction to Network Modeling: Network modeling, Computer Network as a discrete event system, Modeling and measurement tools, Network performance metrics – first order and second order metrics, Network capacity, Difference between throughput and capacity Network Calculus: Models for data flows, arrival curves and service curves, Greedy shapers, Basic min-plus and max-plus calculus, min-plus and max-plus systems, Optimal smoothing, FIFO systems and aggregate scheduling, Time varying shapers, Systems with losses, Case studies – (1) Analyzing spanning tree based data forwarding using network calculus, (2) Bound on loss rate Stochastic Scheduling and Resource Allocation: Stochastic scheduling, dynamic resource allocation, Dynamic programming models for stochastic scheduling, Queuing networks – open loop and closed loop networks, Jackson networks, Network fairness – proportional and max-min fairness, Markov process and its application for analyzing network resource allocation and fairness, available bandwidth estimation, Case studies – (1) TCP/IP flow and congestion control, (2) Modeling dynamic routing and scheduling as a queuing network problem, (3) Analysis of IEEE 802.11 channel access using two dimensional Markov process. Network Games: Introduction to game theory, Zero sum games, Nash equilibrium, Pareto optimality, Cooperative and Non-cooperative games, General network games – resource sharing games, routing games, congestion games, Mechanism design, Case studies – (1) Selfish routing in networks and price of anarchy, (2) Oblivious routing, (3) Network resource allocation games Protocol Analysis: Modeling discrete event system using petri-nets, basics of petri nets, stochastic petri nets, queuing petri nets, properties of petri nets, structural analysis of petri nets, Petri net modeling tools – simQPN, Case studies – (1) Wireless channel model using stochastic petri net, (2) Data center network throughput analysis using queuing Petri Nets

## **Recommended Readings**

**Text Books:-**

1. "Routing, Flow, and Capacity Design in Communication and Computer Networks", Michał Pióro, Deepankar Medhi, ISBN: 0125571895, Publisher: Morgan Kaufmann
2. The Network Calculus Book by Jean-Yves Le Boudec and Patrick Thiran is available for free download: [http://icalwww.epfl.ch/PS\\_files/NetCal.htm](http://icalwww.epfl.ch/PS_files/NetCal.htm)
3. Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach" Morgan Kaufman Publishers
4. Dimitri P. Bertsekas and Robert G. Gallager, "Data Networks": Materials are available at <http://web.mit.edu/dimitrib/www/datanets.html>
5. "Network Optimization: Continuous and Discrete Models", D. Bertsekas
6. Research Publications - will be discussed and distributed time to time

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST863**

**Course Name : Pattern Recognition**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** An undergraduate level understanding of probability, statistics and linear algebra is assumed. A basic knowledge of Python is essential.

## **Course Contents**

The classification process: features, training and learning, approaches to classification Non metric methods: Information, Entropy and Impurity, decision tree classifier- ID3, C4.5. Discriminant functions: linear discriminant functions, piece-wise linear discriminant functions, generalized discriminant functions. Statistical pattern recognition: measured data and measurement errors, probability theory, conditional probability and Bayes rule, Naive Bayes classifier, Continuous random variables, The multivariate Gaussian, Covariance matrix and Mahalanobis distance Parametric learning: Bayesian decision theory, discriminant functions and decision boundaries, MAP (Maximum A Posteriori Estimator) Non Parametric learning: Histogram estimator and Parzen windows, k-NN classification, Artificial Neural Networks, Kernel Machines, SVM. Feature extraction and selection: reducing dimensionality, feature selection- Inter/Intra class distance, Feature extraction: Principal component analysis, Linear discriminant analysis. Unsupervised learning: Clustering, K- Means clustering, Fuzzy c-Means clustering, (Agglomerative) Hierarchical clustering. Estimating and Comparing Classifiers: No free lunch, Bias and variance trade-off, cross-validation and resampling methods, Measuring classifier performance, Comparing classifiers- ROC curves, McNemar's test, other statistical tests.

## **Recommended Readings**

### **Text Books:-**

1. Pattern Classification, Duda Hart, Wiley
2. Pattern Recognition and Classification, Geoff Dougherty, Springer
3. Statistical Pattern Recognition, Andrew R Webb, Wiley
4. Pattern Recognition and Machine Learning, Christopher Bishop, Springer

5. Pattern Recognition and Image Analysis, Earl Gose, Johnsonbaugh, PHI

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CIL736**

**Course Name : Program Analysis**

**Credits : 3    L - 3   T - 0   P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Introduction to analysis tools: debugging, disassembly, emulators, virtualization Introduction: Program Representation, Syntactic Analysis, Program Semantics, Static and dynamic analysis, Syntactic Analysis, Dataflow Analysis and Abstract Interpretation, Interprocedural analysis, Context-sensitive, Pointer analysis, Call Graph Construction, slicing and profiling, Control Flow Analysis, Dynamic Analysis for Data Race Detection Model Checking, Symbolic execution, Program Repair, Hoare Logic, SMT solvers

## **Recommended Readings**

### **Text Books:-**

1. Pierce, Benjamin C. Types and Programming Languages. MIT Press, 2002.
2. Winskel, Glynn. The Formal Semantics of Programming Languages: An Introduction. MIT Press, 1993.
3. Nielson, Nielson, and Hankin. Principles of Program Analysis. Springer, 2010.
4. Baier, and Katoen. Principles of Model Checking. MIT Press, 2008.
5. Chlipala, Adam. Certified Programming with Dependent Types: A Pragmatic Introduction to the Coq Proof Assistant. MIT Press, 2013.

# **MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST864**

**Course Name : Public Key Infrastructure and Trust Management**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Public key infrastructure - components and architecture. PKI interoperability, deployment and assessment PKI data structures – certificates, validation, revocation, authentication, cross-certification. Repository, Certification Authority (CA) and Registration Authority (RA), trusted third party, digital certificates PKI services – authentication, non-repudiation, privilege management, privacy, secure communication. Key management – certificate revocation list, root CA, attacks on CA, key backup. PKI standards – SSL, LDAP, IPSec, X.500, X.509, S/MIME Trust models – strict v/s loose hierarchy, four corners distribution. Certificate path processing – path construction and path validation.

## **Recommended Readings**

### **Text Books:-**

1. AshutoshSaxena, Public Key Infrastructure, Tata McGraw Hill
2. Carlisle Adams, Steve Lloyd. Understanding PKI: Concepts, Standards, and Deployment Considerations, Addison Wesley.
3. John R. Vacca. Public Key Infrastructure: Building Trusted Applications and Web Services, AUERBACH.
4. MessaoudBenantar, Introduction to the Public Key Infrastructure for the Internet, Pearson Education.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST865**

**Course Name : Quantum Cryptography**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Preliminaries: Quantum Information Theory, Quantum Information Theory, Unconditional Secure Authentication and Entropy. Quantum Key Distribution: Quantum Channel, Public Channel, QKD Gain, Finite Resources, Adaptive Cascade: Introduction, Error Correction and the Cascade Protocol, Adaptive Initial Block-Size Selection, Fixed Initial Block-Size, Dynamic Initial Block-Size. Attack Strategies on QKD Protocols: Attack Strategies in an Ideal Environment, Individual Attacks in a Realistic Environment. QKD Systems, Statistical Analysis of QKD Networks in Real-Life Environment: Statistical Methods, Results of the Experiments, Statistical Analysis. QKD Networks Based on Q3P : QKD Networks, PPP, Q3P, Routing and Transport. Quantum-Cryptographic Networks from a Prototype to the Citizen. The Ring of Trust Model, Model of the Point of Trust Architecture, Communication in the Point of Trust Model, Exemplified Communications, A Medical Information System Based on the Ring of Trust.

## **Recommended Readings**

### **Text Books:-**

1. Quantum Cryptography and Secret-Key Distillation, Gilles van Assche, Cambridge University Press, 2006.
2. Paul Kaye, Raymond Laflamme, and Michele Mosca, An Introduction to Quantum Computing, Oxford University Press (2007).
3. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press (2000).

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST866**

**Course Name : Security Analysis of Protocols**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Cryptographic background; Authentication, Key establishment and IP security; Denial of service; Anonymity and MIX networks; Fairness and contract signing, Privacy and protection of individual information; Wireless security (mobile phones, WiFi); Protocol analysis tools: Finite-state checking; Infinite-state symbolic analysis; Probabilistic model checking; Game-based verification; Process algebras (spi-calculus and applied pi calculus); Protocol logics (BAN, DDMP, Isabelle); Introduction to Probabilistic polynomial time calculus; Relating cryptographic and formal models.

## **Recommended Readings**

### **Text Books:-**

1. Latest reputed conference and journal articles as chosen by the instructor.
2. Maximum Security, 2nd Edition, SAMS Books by Anonymous, 1998,
3. Maximum Linux Security, SAMS Books by Anonymous, 2000, ISBN: 0-672- 31670-6.
4. 10 Risks of PKI: What You're not Being Told about Public Key Infrastructure, by Ellison and Schneier

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST860**

**Course Name : Machine Learning**

**Credits : 3    L - 3   T - 0   P - 0**

**Course Type : Elective**

**Prerequisites:** Basic understanding of probability and statistics, linear algebra and calculus. A basic knowledge of programming (preferably Python) is essential.

## **Course Contents**

Advanced linear Algebra (e.g., SVD). The learning problem – learning versus design, types of learning- supervised, unsupervised, reinforcement and other views of learning. Linear Modelling: A least squares approach, linear modeling, making predictions, vector/matrix notation, linear regression, nonlinear response from a linear model. Generalization and over-fitting. The Bayesian approach to machine learning: exact posterior, marginal likelihoods Probability based learning: Bayes theorem, Bayesian prediction, conditional independence and factorization, the Naive Bayes model. Error based learning: simple linear regression, multi variable linear regression with gradient descent Logistic regression – gradient descent, non linear transformations the Z space. Similarity based learning: nearest neighbor, k- nearest neighbors, efficient distance computations: the KD trees Information based learning: learning and trees, Classification and regression trees. Ensemble methods, Boosting, Bagging, Random forests. Neural networks – the perceptron, Multilayer perceptron, activation functions, gradient descent, deriving back propagation. Multi-task and transfer learning, Deep learning. Linear discriminant analysis (LDA), Principal component analysis (PCA) SVM- optimal separation, the margin and support vectors, a constrained optimization problem, kernels – polynomial, radial basis, sigmoid Performance Measures and Evaluation – for categorical targets, prediction scores, multinomial targets, continuous targets. Clustering – the general problem, hierarchical and partitional clustering, K-means clustering.

## **Recommended Readings**

### **Text Books:-**

1. Learning from Data, Yaser S Abu-Mostafa, AML books
2. Machine learning, Marsland, CRC press

3. An Introduction to Machine Learning, Kubat Miroslav, Springer
4. Fundamentals of Machine Learning for predictive data analytics, John D Kelleher, MIT Press
5. Learning from Data, Yaser S Abu-Mostafa, AML books

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST867**

**Course Name : Selected Topics in Cryptography**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: Maths**

## **Course Contents**

Basic Concepts: Information theoretic vs. computational security. One way functions, Pseudo randomness generators and functions, Permutations, hash functions. Private-key encryption using pseudo randomness. Private-key authentication. – Public key encryption (and number theory). Public key authentication. Interactive protocols: Touch of complexity theory, Interactive proof systems; 0-knowledge proof systems, 0-knowledge authentication, Electronic cash; non-interactive zero-knowledge. Oblivious transfer: Definitions, constructions, and applications, Secure Multiparty computations, Database (differential) privacy. – Proofs of work – Block-chain consensus protocols.

## **Recommended Readings**

### **Text Books:-**

1. Introduction to Modern Cryptography: Principles and Protocols, by Jonathan Katz and Yehuda Lindell
2. A Graduate Course in Applied Cryptography by Dan Boneh and Victor Shoup
3. The Joy of Cryptography by Mike Rosulek.
4. Oded Goldreich: Foundations of Cryptography Vol 1 and Vol2

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST868**

**Course Name : Social Network Analysis**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Data Structures and Algorithms

## **Course Contents**

Network Models: Properties of Real-World Networks: Degree Distribution, Clustering Coefficient, Average Path Length. Random Graphs , Small-World Model, Preferential Attachment Model, Modeling of Real-World Networks using Random Graphs, Small-World Model and Preferential Attachment Model Network Measures: Centrality: Degree Centrality, Eigenvector Centrality, Katz Centrality, PageRank, Centrality, Closeness Centrality, Group Centrality. Transitivity and Reciprocity, Balance and Status, Similarity: Structural Equivalence, Regular Equivalence. Community Analysis: Community Detection, Community Detection Algorithms: Member-Based Community Detection, Group-Based Community Detection. Community Evolution: How Networks Evolve, Community Detection in Evolving Networks. Community Evaluation: Evaluation with Ground Truth, Evaluation without Ground Truth Recommendation: Classical Recommendation Algorithms: Content-Based Methods, Collaborative Filtering (CF), Extending Individual Recommendation to Groups of Individuals, Recommendation Using Social Context, Evaluating Recommendations: Evaluating Accuracy of Predictions, Evaluating Relevancy of Recommendations Graph Representation Learning, Knowledge Graphs and Meta Paths, Graph Convolutional Networks, Link Prediction, Influence Maximization & Outbreak Detection.

## **Recommended Readings**

### **Text Books:-**

1. Networks, Crowds, and Markets: Reasoning About a Highly Connected World by David Easley and Jon Kleinberg.
2. Networks: An introduction by Mark Newman.
3. The Development of Social Network Analysis” by Linton C Freeman

4. Zafarani, Reza, Mohammad Ali Abbasi, and Huan Liu. Social media mining: an introduction. Cambridge University Press

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST869**

**Course Name : SOFTWARE TESTING & VALIDATION**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Software engineering, basic computer programming skills

## **Course Contents**

Testing Environment and Test Processes: Software Testing Environment, Overview of Software Testing Process, Organizing for Testing, Developing the Test Plan, Verification Testing, Analyzing and Reporting Test Results, Acceptance Testing. Levels of Testing, Unit Testing, Integration Testing, Defect Bash Elimination. System Testing, Usability and Accessibility Testing, Configuration Testing, Compatibility Testing. Functional and Non-functional system testing, Compliance Testing, Load Testing, Performance Testing and Security Testing. Static and dynamic testing, Black-box or functional testing, Equivalence partitioning, BVA, structural, White box or glass box testing, Mutation Testing, Data flow testing. Test Automation: Software Testing Tools, Software Test Automation, Debugging, Case study.

## **Recommended Readings**

### **Text Books:-**

1. Srinivasan Desikan and Gopaldaswamy Ramesh, “Software Testing – Principles and Practices”, Pearson Education,.
2. A.P. Mathur, Foundations of Software Testing, Pearson publications
3. NareshChauhan , “Software Testing Principles and Practices ” Oxford University Press , New Delhi .
4. LleneBurnstein, “ Practical Software Testing”, Springer International Edition.
5. RenuRajani, Pradeep Oak, “Software Testing – Effective Methods, Tools and Techniques”, Tata McGraw Hill.
6. William Perry, “Effective Methods of Software Testing”, Third Edition, Wiley Publishing.

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST870**

**Course Name : VLSI Algorithms**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites: None**

## **Course Contents**

Logic synthesis & verification: Introduction to combinational logic synthesis, Binary Decision Diagram, Hardware models for High-level synthesis. VLSI Algorithms Partitioning: Problem formulation, classification of partitioning algorithms, Group migration algorithms, simulated annealing & evolution, other partitioning algorithms. Placement, floor planning & pin assignment: Problem formulation, simulation base placement algorithms, other placement algorithms, constraint-based floorplanning, floor planning algorithms for mixed block & cell design. General & channel pin assignment. Global Routing: Problem formulation, classification of global routing algorithms, Maze routing algorithm, line probe algorithm, Steiner Tree based algorithms, ILP based approaches. Detailed routing: problem formulation, classification of routing algorithms, single layer routing algorithms, two-layer channel routing algorithms, three-layer channel routing algorithms, and switchbox routing algorithms. Over the cell routing & via minimization: two layers over the cell routers, constrained & unconstrained via minimization. Compaction: problem formulation, one-dimensional compaction, two dimension-based compaction, hierarchical compaction.

## **Recommended Readings**

### **Text Books:-**

1. Naveed Sherwani, "Algorithms for VLSI Physical Design Automation", 3rd

# MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**Department/Centre : Department of Computer Science & Engineering**

**Course Code : 21CST849**

**Course Name : Blockchain Technologies**

**Credits : 3    L - 3    T - 0    P - 0**

**Course Type : Elective**

**Prerequisites:** Network Security, Cryptography,

## **Course Contents**

INTRODUCTION TO BLOCKCHAIN Distributed Ledger Technology, Decentralization, Bitcoin Network and Architecture, Block in a Blockchain, Advantages over Traditional Databases, Mining Mechanism, Types of Blockchain: Public, Private, Consortium, Cryptography: Elliptic Curve Cryptography, Hash Functions, Merkle Tree, Merkle Patricia Trie, Digital Signature, Wallets and Keys, User Addresses and Privacy CRYPTO CURRENCY History, Distributed ledger, Creation of Coins, Double spending, Bitcoin protocols, Transaction in Bitcoin Network, AltCoins, Ethereum, EVM, Accounts, Transactions, Gas, Fees, Smart Contracts, Eth 2.0 MINING AND CONSENSUS Definitions, Types of Mining Algorithms, Proof of Work, Proof of Stake, Proof of Burn. Sharding Chains SMART CONTRACTS ON ETHEREUM Setting up Ethereum Node using Geth Client, Smart Contracts and DApps, Truffle, Ganache CLI, Metamask, Remix, Solidity, Writing and Deploying Smart Contracts in Solidity, Connection to Web3.js Library, Vulnerabilities in Smart Contracts, Attacks, Prevention of Attacks, Decentralized Autonomous Organization (DAO), Building an Initial Coin Offering (ICO). BLOCKCHAIN USE CASES AND APPLICATIONS Use-Cases in Cryptocurrency and Other Sectors like Finance, Voting System, and Healthcare, etc. Future of Blockchain.

## **Recommended Readings**

### **Text Books:-**

1. Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction