OPERATING SYSTEM
(DCS301)

Objective: To give knowledge about principles of modern operating system.	
Unit	**Topic**
I	**Introduction to Operating Systems:** Role and purpose of operating systems, Operating System Services, Classification of Operating systems, Operating System Structure, System Calls.
II	**CPU Scheduling:** Process vs. Program, Process States, Process Transition Diagram, Process Control Block, Process Address Space, Schedulers, Scheduling Concepts, Performance Criteria, Scheduling Algorithms, Threads, Deadlock Problem, Deadlock Characterization, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Methods for Deadlock Handling.
III	**Inter-process Communication:** Race conditions, Critical sections, Mutual exclusion, Critical-section problem, Algorithmic approach to implementing critical sections, Hardware support for process synchronization, Semaphores, Mutexes, Monitors. **Classic Problems of Synchronization:** Producers-consumers with bounded buffers problem, Readers-writers problem, Dining-philosophers problem
IV	**Memory Management:** Introduction, Logical and Physical Address Space, Swapping, Contiguous Memory Allocation, Fragmentation, Paging, Structure of Page Table, Segmentation, Segmentation with Paging. Virtual Memory: Demand Paging, Performance of Demand Paging, Page Replacement Algorithms, Allocation of Frames, Thrashing
V	**File system:** File Concept, Access Methods, Directories, Mounting of File-System, File-System Structure, File-System Implementation, Allocation Methods. I/O Devices, and I/O Subsystems, I/O Buffering, Disk Storage and Disk Scheduling, Disk Management, RAID.

Text Book (s) :

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Concepts, John Wiley.
2. William Stallings, Operating Systems: Internals and Design Principles. PHI,
3. Dhananjay M. Dhamdhere, “Operating Systems A Concept-Based Approach”, TMH

DATABASE MANAGEMENT SYSTEM
(DCS302)

Objective: To familiarize the students with databases and techniques of retrieving and storing information.	
Unit	**Topic**
I	**Database system architecture:** Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML). **Data models:** Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.
II	**Relational query languages:** Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server. **Relational database design:** Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design. **Query processing and optimization:** Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.
III	**Storage strategies**: Indices, B-trees, hashing. **Transaction processing:** Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.
IV	**Database Security:** Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.
V	**Advanced topics:** Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

Text Book (s):

1. “Database System Concepts”, 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.

2. “Principles of Database and Knowledge – Base Systems”, Vol 1 by J. D. Ullman, Computer Science Press.

3. “Fundamentals of Database Systems”, 5th Edition by R. Elmasri and S. Navathe, Pearson Education

4. “Foundations of Databases”, Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley

DATA STRUCTURES
(DCS303)

Objective: To enable them to write algorithms for solving problems with the help of fundamental data structures information.	
Unit	**Topic**
I	**Introduction:** Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. **Searching:** Linear Search and Binary Search Techniques and their complexity analysis.
II	**Stacks and Queues**: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.
III	**Linked Lists:** Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.
IV	**Trees:** Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.
V	**Sorting and Hashing:** Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. **Graph:** Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Text Book (s):

1. “Fundamentals of Data Structures”, Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.
2. “Data Structures”, RS Salaria, Khanna Publishing House
3. How to Solve it by Computer”, 2nd Impression by R.G. Dromey, Pearson Education.

STATISTICAL ANALYSIS FOR DATA SCIENCE
(DCS304)

Objective: Understand the fundamentals of data science, data handling and statistical analysis issues.	
Unit	**Topic**
I	**Basic Probability:** Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Variance of a sum, Chebyshev's Inequality.
II	**Probability Distributions**: Continuous random varibales and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.
III	**Basic Statistics:** Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation, Correlation coefficient.
IV	**Applied Statistics:** Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.
V	**Small samples:** Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes, T- Test and ANOVA.

Text Book (s):

(1) Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.
(2) P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall.
(3) S. Ross, A First Course in Probability, 6th Ed., Pearson Education India.
(4) W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley.
(5) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications.
(6) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
(7) Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi.

DIGITAL ELECTRONICS
(EC301)

Objective: Students will demonstrate the ability to Understand working of logic families, logic gates, Combinational and Sequential logic circuits.	
Unit	**Topic**
I	**Fundamentals of Digital Systems and logic families:** Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.
II	**Combinational Digital Circuits**: Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, DeMultiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization
III	**Sequential circuits and system:** A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D types flipflops, applications off lipflops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters
IV	**A/D and D/A Converters:** Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage of requencyandvoltagetotimeconversion,specificationsofA/Dconverters, example of A/D converter ICs
V	**Semiconductor memories and Programmable logic devices:** Memory organization and operation, expanding memory size, classification andcharacteristicsof memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Text Book (s):

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India.

INDUSTRIAL SOCIOLOGY
(AS302)

Objective: The course attempts to analyze the structure and process of industrial organizations from the sociological perspective. The course enables students to have a general view of modern industry.	
Unit	**Topic**
I	Descriptors/Topics Industrial Sociology: Nature, Scope and Importance, Origin and Development, Industry as a social system, Evolution of Working Class , Changing nature of work , Growth of unorganized informal sector. Dynamics of Industrial Relations: Approaches to the study of Industrial Relations, Collective Bargaining – Concepts, Types, Scope and Importance.
II	Descriptors/Topics Industrial Disputes: Concept, Features and Kinds of disputes, Settling disputes, Mediation, Arbitration, Conciliation, Negotiation.
III	Descriptors /Topics Trade Union: Concept, Features, Functions and Types, History of Trade Union Movement in India Trade Unions and Challenges of Privatization and Globalization, Law and work, Decline of Trade Unions.
IV	Descriptors/Topics Dynamics of Industrial Relations: Corporate Social Responsibility, Inclusion of Women in the Corporate Sector, Scope of Industrial Sociology in India , Impact on Employment, Impact on HRD, impact on wages and benefits, Modern Industry in India – Development f Industry in Post-Independence period, The Indian Worker: Features of Indian worker, the contribution of social - Philosophy, family, caste and community in determining the attitude of workers .

Text Book (s):

1. PREMVIR KAPOOOR, Sociology & Economics for Engineers, Khanna Publishing House.
2. GISBERT PASCAL, Fundamentals of Industrial sociology, Tata McGraw Hill, New Delhi.
3. MAMORIA C.B. And MAMORIA S., Dynamics of Industrial Relations in India.
4. SINHA G.P. and P.R.N. SINHA, Industrial Relations and Labour Legislations, New Delhi, Oxford.
5. S.C. SHARMA, Industrial Safety and Health Management, Khanna Book Publishing Co. (P) Ltd.

OPERATING SYSTEM LAB
(DCS351)

LIST OF EXPERIMENTS

1. Implement CPU Scheduling Policies:
i. SJF ii. Priority iii. FCFS iv. Multi-level Queue

2. Implement file storage allocation technique:
i. Contiguous(using array)
ii. Linked –list(using linked-list)
iii. Indirect allocation (indexing)

3. Implementation of contiguous allocation techniques:
i. Worst-Fit ii. Best- Fit iii. First- Fit

4. Calculation of external and internal fragmentation
i. Free space list of blocks from system ii. List process file from the system

5. Implementation of compaction for the continually changing memory layout and calculate total movement of data

6. Implementation of resource allocation graph RAG)

7. Implementation of Banker's algorithm

8. Conversion of resource allocation graph (RAG) to wait for graph (WFG) for each type of method used for storing graph.

9. Implement the solution for Bounded Buffer (producer-consumer)problem using inter process communication techniques-Semaphores.

10. Implement the solutions for Readers-Writers problem using inter process communication technique –Semaphore.

DATABASE MANAGEMENT SYSTEM LAB
(DCS352)

LIST OF EXPERIMENTS

1. Write the queries for Data Definition and Data Manipulation Language.
2. Write SQL queries using logical operators.
3. Write SQL queries using SQL operators
4. Write SQL query using character, number, date and group functions
5. Write SQL queries for relational algebra
6. Write SQL queries for extracting data from more than one table
7. Write SQL queries for sub queries, nested queries
8. Write program of PL/SQL
9. Concepts for ROLL BACK, COMMIT & CHECK POINTS
10. Create VIEWS, CURSORS and TRGGERS.

DATA STRUCTURES LAB
(DCS353)

LIST OF EXPERIMENTS

1. To implement addition and multiplication of two 2D arrays.
2. To transpose a 2D array.
3. To implement stack using array.
4. To implement queue using array.
5. To implement circular queue using array.
6. To implement stack using linked list.
7. To implement queue using linked list.
8. To implement circular queue using linked list.
9. To implement binary tree using linked list.
10. To implement binary search tree using linked list.
11. To implement tree traversals using linked list.
12. To implement BFS using linked list.
13. To implement DFS using linked list.
14. To implement Linear Search.
15. To implement Binary Search.
16. To implement Bubble Sorting.
17. To implement Selection Sorting.
18. To implement Insertion Sorting.
19. To implement Merge Sorting.
20. To implement Heap Sorting.

DIGITAL ELECTRONICS LAB
(EC-351)

LIST OF EXPERIMENTS: -

1. Study of TTL gates – AND; OR; NOT; NAND; NOR; EX-OR; EX-NOR.
2. Design and realize a given function using K-maps and verify its performance.
3. Implementation and Verification of Decoder/De-Multiplexer and Encoder using Logic Gates.
4. Implementation of 4x1 multiplexer using Logic Gates.
5. To Design & Verify the Operation of Magnitude Comparator
6. To verify the truth tables of S-R; J-K; T and D type flip flops
7. Design, and Verify the 4- Bit Synchronous Counter
8. Design, and Verify the 4-Bit Asynchronous Counter.
9. To verify the operation of bi-directional shift register.
10. Implementation of 4-Bit Parallel Adder Using 7483 IC

COMPUTER NETWORKS
(DCS401)

Objective: The objective of this course is to provide basic exposure to computer networks theory and implementations.

Unit	Topic
I	**Introduction:** Networks, Internet, Network Components, Network Categories, Applications of Computer Networks **Reference Models:** Concept of Layering, OSI Model, TCP/IP Protocol Suite, Functions of Layers **Physical Layer:** Transmission Mode, Physical Topology, Multiplexing, Transmission Media, Switching
II	**Data Link Layer:** Design Issues, Error Detection and Correction Techniques, Elementary Data Link Protocols, Sliding Window Protocols, Multiple Access Protocols, Ethernet, Connecting Devices
III	**Network Layer:** Logical addressing, IPv4 Addresses, NAT, IPv6 Addresses, Internet Protocol, IPv4, IPv6, Internetworking, Internet Control Protocols, Routing Algorithms, Distance Vector Routing, Link State Routing, Routing in the Internet
IV	**Transport Layer:** Process-to-Process Delivery, Transport Layer Protocols, UDP, User Datagram, TCP, TCP Segment, TCP Connection, Flow Control and Error Control, TCP Transmission Policy, Principles of Congestion Control, TCP Congestion Control, Quality of Service.
V	**Application Layer:** Principles of Network Applications, WWW and HTTP, Non-Persistent and Persistent Connections, Cookies, Web Caching, File Transfer, Remote Logging, Electronic Mail in the Internet, Domain Name System, Security: Introduction, Cryptography and Cryptanalysis, Public Key Cryptography Algorithms, RSA Algorithm, DES, Authentication and Authorization

References:

1. AS Tanenbaum, DJ Wetherall, Computer Networks, Prentice-Hall, 2010. .
2. LL Peterson, BS Davie, Computer Networks: A Systems Approach, Morgan-Kauffman, 2011.
3. W Stallings, Cryptography and Network Security, Principles and Practice, Prentice-Hall, 2005.

ARTIFICIAL INTELLIGENCE
(DCS402)

Objective: To learn the concepts of Artificial Intelligence and the methods of solving problems using Artificial Intelligence.

Unit	Topic
I	**Introduction:** Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence , Application of Artificial Intelligence Communication - Communication among agents, natural language processing, formal grammar, parsing, grammar
II	**Introduction to Search**: Searching for solutions, Uniformed search strategies, Informed search Strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning.
III	**Knowledge Representation & Reasoning:** Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.
IV	**Decision making-** Utility theory, utility functions, and Decision theoretic Expert systems. Default reasoning, Fuzzy sets and fuzzy logic; AI languages and tools - Lisp, Prolog,
V	**Pattern Recognition :** Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA),

References:

1. Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, McGraw Hill, 2008.
2. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2007.
3. Peter Jackson, “Introduction to Expert Systems”, Pearson Education, 2011.

WEB TECHNOLOGY
(DCS403)

Objective: The objective of this course is to provide basic web technology concepts that are required for developing web applications.

Unit	Topic
I	**Introduction to Web Technology:** Internet, WWW, Web Browsers with suitable examples, Web Servers with suitable examples, URL, HTTP, MIME. Introduction to HTML& DHTML**:** Basic Syntax, HTML Document Structure, Text Formatting, Images, Lists, Links, Tables, Frames, Forms. Cascade Style Sheets**:** Levels Of Style Sheets, Specification Formats, Style Classes, Properties, Colors, Span and Div tags.
II	**Introduction to Java Script:** Overview of java Script, Syntactic characteristics, Primitives, Operator and Expression, control statements, Arrays, functions, errors in scripts, Document Object Model(DOM),Event driven computation, element access in Java script, The navigator Object. Dynamic Document with Java Script : Element positioning, Moving elements, Changing colors and fonts, Dynamic content, Locating the mouse Cursor, Slow movements of elements, Dragging and Dropping Elements.
III	**Introduction to XML:** Syntax of XML, Document Structure, Document type definition, Namespaces, XML Schemas, Document Object model, Presenting XML, Using XML Processors: DOM and SAX.
IV	**Introduction to PHP:** Overview of PHP, general server characteristics, Creating PHP Pages, Form handling, Data Base access with PHP & MySql. JSP & Servlets: Basics of JSP, Tags, Session Handling, Redirection and Basics of Servlet
V	**Database Connectivity:** Connection to various databases (MySQL, Oracle). Database connectivity in PHP, JSP, Other server languages, Basic SQL Queries and Statements.

Text Book (s):

1. Programming world wide web- Robert W.Sebesta , Pearson.
2. Beginners PHP, Apache, MY Sql, Web Development, by Michael Glass, Wrox.

Python Programming
(DCS404)

Objective: To familiarize the students with advanced databases and techniques of retrieving and storing information.

Unit	Topic
I	**Introduction To Python:** Installation and Working with Python Understanding Python variables Python basic Operators Understanding python blocks **Values and Variables :** Integer and String Values, Identifiers, User Input, String Formatting, Expressions and Arithmetic Examples
II	**Python Data Types:** Declaring and using Numeric data types: int, float, complex Using string data type and string operations Defining list and list slicing Use of Tuple data type
III	**Python Conditional Statements and looping:** If, If- else, Nested if-else For, While Nested loops
IV	**Python String, List And Dictionary Manipulations:** Building blocks of python programs, Understanding string in build methods, List manipulation using in build methods ,Dictionary manipulation Programming using string, list and dictionary in build functions
V	**Python Object Oriented Programming:** Oops Concept of class, object and instances Constructor, class attributes and destructors ,Real time use of class in live projects ,Inheritance , overlapping and overloading operators Adding and retrieving dynamic attributes of classes Programming using Oops support..

References:

1. Chun, J Wesley, Core Python Programming, Second Edition, Pearson
2. Barry, Paul, Head First Python, 2nd Edition, O Rielly
3. Lutz, Mark, Learning Python, 4th Edition, O Rielly

Data Warehouse and Data Mining
(DCS405)

Objective: To introduce concepts and techniques of data warehousing.	
Unit	**Topic**
I	**Introduction to Data Warehouse:** A multidimensional Data Model – Data Warehouse architecture – Data preprocessing- Data cleaning – Data integration and Transformation.
II	**Introduction to Data Mining:** Data Mining Functionalities – Classification of Data Mining systems, Major issues in Data mining.
III	**Data Mining primitives:** Task – relevant data – kind of knowledge to be mined – Background knowledge –interestingness measures– presentation & visualization of discovered pattern - Data Mining Query language –Designing Graphical User interfaces based on DMQL - Architecture of Data mining.
IV	**Basic concepts:** market basket analysis - Mining single dimensional Boolean association rules from transactional databases. Classification & prediction: What's classification - issues regarding classification and prediction – Bayesian classification – prediction: linear – non linear.
V	**Cluster:** Types of Data in cluster analysis, Major clustering methods. Data mining applications.

References:

1. Han J. & Kamber, M, "Data Mining: Concepts and Techniques", 3 rd Edition,
2 Morgan Kaufmann, 2011. Immon.W.H., "Building the Data Warehouse", Wiley Dream
3. Anahory S., Murray, D, "Data Warehousing in the Real World", Pearson.

COMPUTER NETWORKS LAB
(DCS451)

LIST OF EXPERIMENTS

1. To learn basics of the packet tracer simulator tool.
2. Write a program in C to implement bit stuffing and character stuffing.
3. To connect the computers in Local Area Network and to detect collision of packets.
4. To configure DHCP and DNS server for a given network in packet tracer simulator tool.
5. Write a C program to get the MAC or Physical address of the system using ARP (Address Resolution Protocol) and to subnet a given network according to the requirements in packet tracer simulator tool. .
6. To configure router using command line. Also observe the datagram formats in packet tracer simulator tool.
7. To configure NAT for a given network in packet tracer simulator tool.
8. Write a program to implement TCP & UDP Sockets.
9. Write a C program to transmit a character, a string and a file from one computer to another using RS-232 cable and to configure static routing in packet tracer simulator tool.
10. To configure dynamic routing protocols in packet tracer simulator tool.

ARTIFICIAL INTELLIGENCE LAB
(DCS452)

LIST OF EXPERIMENTS

1. WAP in Prolog to have an introduction of Prolog fundamentals: constants, predicates, arguments, variables.
2. WAP in Prolog to have an introduction of Tests, Backtracking.
3. WAP in Prolog to have an introduction of Recursion.
4. WAP in Prolog to have an introduction of State-Space Search: DFS
5. WAP in Prolog to have an introduction of State-Space Search: BFS
6. Write a program to implement supervised learning on IRIS Dataset using Bayes classifier.

7-8. Write a program to implement Genetic Algorithm to find out the optimal solution of different equation.

9. Write a program to implement Nearest Neighbour classification technique.
10. Write a program to implement k-means clustering on IRIS Dataset.

WEB TECHNOLOGY LAB
(DCS453)

LIST OF EXPERIMENTS

1. Write a program in HTML to display different styles of heading text.
2. Write a program to display the processes to be followed for a patient when he enters for a complete check-up. Use ordered lists and unordered lists.
3. Write a program to display a traditional Newspaper with the use of table tags.
4. With the help of “IMAGE” tags write a program to display the image along with some contents.
5. Use “Anchor” tag to write a program for displaying various Menus.
6. Use mapping technique, to map a particular part of image and move the control corresponding to that area. For e.g., in an image, if there are bat, ball, stump etc. When you click stump control should move to a file call St.htm.
7. Create frames that have details about various cities.
8. Create a form to display the kinds of food available in a Restaurant. (Use checkboxes wherever necessary)
9. Write a program to “reload” a page automatically once in 5 seconds.
10. Write a program using CSS to set the background colour, font, and paragraph.

Python Programming LAB
(CS454)

LIST OF EXPERIMENTS

1. Implement a sequential search
2. Create a calculator program
3. Explore string functions
4. Implement Selection Sort
5. Implement Stack
6. Read and write into a file
7. Demonstrate usage of basic regular expression
8. Demonstrate use of list
9. Demonstrate use of Dictionaries

DESIGN & ANALYSIS OF ALGORITHM
(DCS501)

Objective: To understand the importance of algorithm and its complexity of an algorithm in terms of time and space complexities.

Unit	Topic
I	**Introduction**: Algorithms, Analyzing algorithms, Complexity of algorithms, Growth of Functions, Recurrences, Substitution method, Iteration method, Master method, Merge Sort, Quick-Sort, Heap Sort, Shell Sort, Sorting in linear time.
II	**Advanced Data Structures:** Red-black trees, Augmenting data structures, Order-statistic tree, B-Trees, Binomial heaps, Fibonacci heaps.
III	**Dynamic Programming:** Elements of dynamic programming, Assembly-line scheduling problem, Matrix chain multiplication, finding longest common subsequence,0/1 Knapsack problem; **Greedy Algorithm:** Elements of greedy strategy, Activity selection problem, Huffman encoding, Task-scheduling problem, Knapsack problem, Amortized analysis.
IV	**Graph Algorithms:** Searching in graph, Spanning trees, Minimum cost spanning trees: Kruskal's and Prim's algorithms; Single source shortest path algorithms, Dijkstra's and Bellman Ford algorithms; All pair shortest paths algorithms, Floyd Warshal's algorithm, Network flow problem. Backtracking, Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of Subsets, Branch and Bound with Examples Such as Travelling Salesman Problem.
V	**String Matching Algorithms:** Naïve string-matching algorithm, Rabin-Karp algorithm, Knuth-Morris-Pratt algorithm. Introduction of NP-completeness, Randomized algorithms and Approximation Algorithms

References:

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein, MIT Press, 2002.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman, Pearson, 2007.
3. "Algorithm Design" by Kleinberg and Tardos, Pearson, 2005.

SOFTWARE ENGINEERING
(DCS502)

Objective: The course is aimed at enhancing skills that will enable the student to develop business software's that are simple reliable and capable of modification as per requirement.

Unit	Topic
I	Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes. Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.
II	Software Requirement Specifications (SRS). Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS. Software Quality Attributes, Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model.
III	Software Design: Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halestead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.
IV	Software Testing: Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards.
V	Software Maintenance and Software Project Management, Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control, An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management.

References:

1. Software Engineering: A Practitioner's Approach, Pressman Roger, TMH, 2009.
2. An Integrated Approach to Software Engineering, Pankaj Jalote. Narosa Pub, 2014.
3. Software Engineering Concepts: Richard Fairly, Tata McGraw Hill, 2015.

Foundation of Data Sciences
(DCS503)

Objective: The objective of this course is to impart necessary knowledge of the mathematical foundations needed for data science and develop programming skills required to build data science applications.

Unit	Topic
I	**Introduction to Data Science:** Concept of Data Science, Traits of Big data, Web Scraping, Analysis vs Reporting.
II	**Introduction to Programming Tools for Data Science :** Toolkits using Python: Matplotlib, NumPy, Scikit-learn, NLTK, Visualizing Data: Bar Charts, Line Charts, Scatterplots, Working with data: Reading Files, Scraping the Web, Using APIs (Example: Using the Twitter APIs), Cleaning and Munging, Manipulating Data, Rescaling, Dimensionality Reduction
III	**Mathematical Foundations: Linear Algebra:** Vectors, Matrices, Statistics: Describing a Single Set of Data, Correlation, Simpson's Paradox, Correlation and Causation, Probability: Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, the Central Limit Theorem,Hypothesis and Inference: Statistical Hypothesis Testing, Confidence Intervals, Phacking, Bayesian Inference
IV	**Machine Learning:** Overview of Machine learning concepts – Over fitting and train/test splits, Types of Machine learning – Supervised, Unsupervised, Reinforced learning, Introduction to Bayes Theorem, Linear Regression- model assumptions, regularization (lasso, ridge, elastic net), Classification and Regression algorithms- Naïve Bayes, K-Nearest Neighbors, logistic regression, support vector machines (SVM), decision trees, and random forest, Classification Errors, Analysis of Time Series- Linear Systems Analysis, Nonlinear Dynamics, Rule Induction, Neural Networks- Learning And Generalization, Overview of Deep Learning.
V	**Case Studies of Data Science Application:** Weather forecasting, Stock market prediction, Object recognition, Real Time Sentiment Analysis.

References:

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition, O'Reilly Media
3. Jain V.K., "Data Sciences", Khanna Publishing House, Delhi.
4. Jain V.K., "Big Data and Hadoop", Khanna Publishing House, Delhi.
5. Jeeva Jose, "Machine Learning", Khanna Publishing House, Delhi.
6. Chopra Rajiv, "Machine Learning", Khanna Publishing House, Delhi.

DEEP LEARNING
(DCS504)

Objective: To teach fundamentals of neuro computing with applications to computer engineering problems.	
Unit	**Topic**
I	Introduction: Neural Network, Human Brain, Biological and Artificial Neurons, Model of Neuron Knowledge Representation, Artificial Intelligence and Neural Network, Network Architecture, Basic Approach of the working of ANN-Training, Learning and Generalization.
II	Supervised Learning: Single Layer Networks, Perception- Linear Separability, Limitations of Multi Layer Network Architecture, Back Propagation Algorithm (BPA) and Other Training Algorithms.
III	Application of Adaptive Multi- Layer Network Architecture, Recurrent Network, Feed-Forword Networks Radial-Basic-Function (RBF) Networks.
IV	Unsupervised Learning: Winner- Task-All Networks, Hamming Networks, Maxnet, Simple Competitive Learning Vector- Quantization, Counter-Propoagation Network, Adaptive Resonance Theory, Kohonen‟s Self Organizing Maps, Principal Component Analysis.
V	**Introduction To Deep Learning, Deep Learning Models,** Restricted Boltzmann Machines, Deep Belief Nets, Convolution Networks, Recurrent Nets, **Deep Learning Platforms**

References:

1. Simon Haykin,"Neural Network – A Comprehensive Foundation‟, Macmillan Pub.
2. K.Mahrotra, C.K. Mohan and Sanjay Ranka, Elements of Artifical Neural Network, MIT Press.
3. J.M. Zurada," Introduction to Artificial Neural network", Jaico Publihers.
4. Limin Fu. "Neural Networks in Computer Intelligence", TMH.

DESIGN & ANALYSIS OF ALGORITHM LAB
(DCS551)

LIST OF EXPERIMENTS

1. Implementation of Quick Sort and Merge Sort.
2. Implementation of Linear-time Sorting Algorithms.
3. Implementation of Red-Black Tree operations.
4. Implementation of Binomial Heap operations.
5. Implementation of an application of Dynamic Programming.
6. Implementation of an application of Greedy Algorithm.
7. Implementation of Minimum Spanning Tree Algorithm.
8. Implementation of Single-pair shortest path Algorithm.
9. Implementation of All-pair shortest path Algorithm.
10. Implementation of String Matching Algorithm.

SOFTWARE ENGINEERING LAB
(DCS552)

LIST OF EXPERIMENTS

1. Introduction to Microsoft Project Professional.
2. Basic steps required to create project and prepare it for data entry (project tasks, sequence the tasks and estimate task duration).
3. Setting up a project [Eating Breakfast] and establish the basic constraints that project will use for its calculation. Analyze the project from different view [Gantt Chart, Network Diagram]
4. Setting up a project [Refurbishment of Workshop] and identifying relationship among the different task and subtask.
5. Setting up a project [Exam Cell Activities] and explain how to enter resources and specific information in Microsoft Project and resources to specific tasks.
6. Case Study: Project Windows 8 (Module works on windows Vista and now transform the module to work on Window 8).

DATA SCIENCE LAB
(DCS553)

LIST OF EXPERIMENTS

1. Introduction to Python Libraries- Numpy, Pandas, Matplotlib, Scikit
2. Perform Data exploration and preprocessing in Python
3. Implement regularised Linear regression
4. Implement Naive Bayes classifier for dataset stored as CSV file.
5. Implement regularized logistic regression
6. Build models using different Ensembling techniques
7. Build models using Decision trees
8. Build model using SVM with different kernels
9. Implement K-NN algorithm to classify a dataset.
10. Build model to perform Clustering using K-means after applying PCA and determining the value of K using Elbow method.

DEEP LEARNING LAB
(DCS554)

LIST OF EXPERIMENTS

1. Setting up the Spyder IDE Environment and Executing a Python Program
2. Installing Keras, Tensorflow and Pytorch libraries and making use of them
3. Artificial Neural Networks
4. Convolutional Neural Networks
5. Image Transformations
6. Image Gradients and Edge Detection
7. Image Contours
8. Image Segmentation
9. Harris Corner Detection
10. Face Detection using Haar Cascades
11. Chatbot Creation

DATA VISUALIZATION
(DCS601)

Objective: The course is designed to enable students to know the basics of data visualization and understand the importance of data visualization and the design and use of visual components and basic algorithms.

Unit	Topic
I	Introduction of visual perception, visual representation of data, Gestalt principles, information overloads.
II	Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.
III	Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents.
IV	Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization.
V	Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, evaluating visualizations

References:

1. Ward, Grinstein Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick: A K Peters, Ltd.
2. E. Tufte, The Visual Display of Quantitative Information, Graphics Press.

MACHINE LEARNING
(DCS602)

Objective: To understand the basic building blocks and general principles that allows one to design machine learning algorithms.	
Unit	**Topic**
I	Basic Concepts, Introduction to Machine Learning, Applications of ML, Design Perspective and Issues in ML, Supervised, Unsupervised, Semi-supervised learning with applications and issues, A Formal Learning Model, The Runtime of Learning.
II	Model (or hypothesis) representation, decision boundary, cost function, gradient descent, regularization, Diagnostic: debugging a learning algorithm, evaluating a hypothesis (Model selection), training/validating/testing procedures, diagnosing bias versus variance and vice versa, regularization and bias/variance, learning curves, Accuracy and Error measures: classifier accuracy measures, predictor error measure, evaluating the accuracy of a classifier or predictor, Confusion metric, precision, recall, tradeoff between both, accuracy.
III	Decision Tree: representation, hypothesis, issues in Decision Tree Learning, Pruning, Rule extraction from Tree, Learning rules from Data, Probabilistic classifier: Bayes rule, Maximum Likelihood Estimation, case study, Support Vector Machine, Nearest Neighbor.
IV	Clustering: Unsupervised learning technique, Similarity and Distance Measures, k-means and k-medoids algorithm, optimization objective, random initialization, choosing value of k, EM algorithm Bayesian networks, bag of words classifiers, N-gram models; Markov and Hidden Markov models, Graphical Models, Combining Multiple Learners.
V	Reinforcement Learning: Elements of Reinforcement Learning, Model-Based Learning, Temporal Difference Learning, Generalization, Design and Analysis of Machine Learning Experiments.

References:

1. Ethem Alpaydin, Introduction to Machine Learning, PHI.
2. H. Witten and E. Frank, Data Mining: Practical Machine Learning Tools and TechniquesMorgan Kaufmann.
3. Tom Mitchell, Machine Learning, McGraw-Hill.

BIG DATA ANALYTICS
(DCS603)

Objective: Student to Understand the Big Data Platform and its use cases.

Unit	Topic
I	Introduction - distributed file system–Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce.
II	Big Data – Apache Hadoop & Hadoop EcoSystem, Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce -, Data Serialization.
III	HDFS-Overview, Installation and Shell, Java API; Hive Architecture and Installation, Comparison with Traditional Database, HiveQL Querying Data, Sorting And Aggregating, Map Reduce Scripts, Joins & Sub queries, HBase concepts, Advanced Usage, Schema Design, Advance Indexing, PIG, Zookeeper , how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper.
IV	Introduction to Data Analysis with Spark, Downloading Spark and Getting Started, Programming with RDDs, Machine Learning with MLlib, What is it?, Where It is Used Types of NoSQL databases, Why NoSQL?, Advantages of NoSQL, Use of NoSQL in Industry, SQL vs NoSQL, NewSQL.
V	Introduction to MongoDB key features, Core Server tools, MongoDB through the JavaScript's Shell, Creating and Querying through Indexes, Document-Oriented, principles of schema design, Constructing queries on Databases, collections and Documents , MongoDB Query Language.

References:

1. Boris lublinsky, Kevin t. Smith, AlexeyYakubovich, "Professional Hadoop Solutions", Wiley, 2013.
2. Chris Eaton,Dirk derooset al. , "Understanding Big data ", McGraw Hill, 2007.
3. Big Data and Analytics , Sima Acharya, Subhashini Chhellappan, Willey, 2007.
4. MongoDB in Action, Kyle Banker,Piter Bakkum , Shaun Verch, Dream tech Press, 2015.

Data Visualization Lab
(DCS651)

List of Experiments:

1. Data Representation: chart types: categorical, hierarchical, relational, temporal & spatial;
2. 2-D: bar charts, Clustered bar charts, dot plots, connected dot plots, pictograms, proportional shape charts, bubble charts, radar charts, polar charts, Range chart,
3. Box-and-whisker plots, univariate scatter plots, histograms word cloud, pie chart, waffle chart, stacked bar chart, back-to-back bar chart, treemap and all relevant 2-D charts.
4. 3-D: surfaces, contours, hidden surfaces, pm3d coloring, 3D mapping;
5. multi-dimensional data visualization; manifold visualization;
6. graph data visualization; Annotation

Machine Learning Lab
(DCS652)

List of Experiments:

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

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

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

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

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

6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

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

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

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

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

Big Data Lab
(DCS653)

List of Experiments:

1. Program involving Resilient Distributed Datasets
2. Program involving Transformations and Actions
3. Program involving Key-Value Resilient Distributed Datasets
4. Program involving Local Variables, Broadcast Variables and Accumulators
5. Program involving Filter, Join, GroupBy, Agg operations
6. Viewing and Querying Temporary Tables
7. Transferring, Summarizing and Analysing Twitter data
8. Program involving Flume, Kafka and Kinesis
9. Program involving DStreams and Dstream RDDs
10. Linear Regression
11. Decision Tree Classification
12. Principal Component Analysis
13. Random Forest Classification
14. Text Pre-processing with TF-IDF
15. Naïve Bayes Classification
16. K-Means Clustering

DATA SECURITY
(DCS701)

Objective: To understand and apply the models of Information Security.	
Unit	**Topic**
I	Data Privacy Ethics and Security Privacy – Reidentification of Anonymous People – Why Big Data Privacy is self-regulating? – Ethics – Ownership – Ethical Guidelines – Big Data Security – Organizational Security.
II	Security, Compliance, Auditing, and Protection Steps to secure big data – Classifying Data – Protecting – Big Data Compliance – Intellectual Property Challenge – Research Questions in Cloud Security – Open Problems.
III	Hadoop Security Design Kerberos – Default Hadoop Model without security - Hadoop Kerberos Security Implementation & Configuration.
IV	Hadoop Ecosystem Security Configuring Kerberos for Hadoop ecosystem components – Pig, Hive, Oozie, Flume, HBase, Sqoop.
V	Data Security & Event Logging Integrating Hadoop with Enterprise Security Systems - Securing Sensitive Data in Hadoop – SIEM system – Setting up audit logging in hadoop cluster.

References:

1. Mark Van Rijmenam, “Think Bigger: Developing a Successful Big Data Strategy for Your Business”, Amazon, 1 edition

2. Frank Ohlhorst John Wiley & Sons, “Big Data Analytics: Turning Big Data into Big Money”, John Wiley & Sons.

3. Sherif Sakr, “Large Scale and Big Data: Processing and Management”, CRC Press.

4. Ben Spivey, Joey Echeverria, “Hadoop Security Protecting Your Big Data Problem”, O’Reilly Media.

Internet of Things
(DCS702)

Objective: The objective of this course is to impart necessary and practical knowledge of components of Internet of Things and develop skills required to build real-life IoT based projects.	
Unit	**Topic**
I	Introduction to IoT :Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT.
II	Elements of IoT Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces.
III	Software Components- Programming API's (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.
IV	IoT Application Development: Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.
V	IoT Case Studies: IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation

References:

1. Vijay Madisetti, Arshdeep Bahga, İnternet of Things, "A Hands on Approach", University Press
2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
4. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi
5. Adrian McEwen, "Designing the Internet of Things", Wiley
6. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill

SPEECH AND NATURAL LANGUAGE PROCESSING
(DCS703)

Objective: To teach how to design, code, debug and document programs using techniques of good programming style.	
Unit	**Topic**
I	Introduction to Natural Language Understanding: The study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English syntax.
II	Introduction to semantics and knowledge representation, Some applications like machine translation, database interface.
III	Grammars and Parsing: Grammars and sentence Structure, Top-Down and Bottom-Up Parsers, Transition Network Grammars, Top-Down Chart Parsing. Feature Systems and Augmented Grammars: Basic Feature system for English, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.
IV	Grammars for Natural Language: Auxiliary Verbs and Verb Phrases, Movement Phenomenon in Language, Handling questions in Context-Free Grammars. Human preferences in Parsing, Encoding uncertainty, Deterministic Parser.
V	Ambiguity Resolution: Statistical Methods, Probabilistic Language Processing, Estimating Probabilities, Part-of-Speech tagging, Obtaining Lexical Probabilities, Probabilistic Context-Free Grammars, Best First Parsing. Semantics and Logical Form, Word senses and Ambiguity, Encoding Ambiguity in Logical Form.

References:

1. Akshar Bharti, Vineet Chaitanya and Rajeev Sangal “NLP: A Paninian Perspective”, PHI.
2. James Allen “Natural Language Understanding” Pearson.

Industrial Training
(DCS751)

Contents: Four weeks of work at industry site
Supervised by an expert at the industry
Students have to maintain a written record of the assignments, progress and accomplishments. They have to submit a report at the end of this training. An oral presentation on their experiences and the knowledge gained during their work.

Mode of Evaluation

Oral viva - voce (50%)
Report (50%)

Project -I
(DCS752)

The object of *Project Work I* is to enable the student to take up investigative study in the broad field of *Computer Science & Engineering*, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

1) Survey and study of published literature on the assigned topic;
2) Working out a preliminary Approach to the Problem relating to the assigned topic;
3) Conducting preliminary
4) Analysis/Modeling/Simulation/Experiment/Design/Feasibility;
5) Preparing a Written Report on the Study conducted for presentation to the
6) Department;
7) Final Seminar, as oral Presentation before a Departmental Committee.

Project Work II & Dissertation
(DCS851)

The object of *Project Work II & Dissertation* is to enable the student to extend further the investigative study taken up under *EC P1*, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

· In depth study of the topic assigned in the light of the Report prepared under *EC P1;*
· Review and finalization of the Approach to the Problem relating to the assigned topic;
· Preparing an *Action Plan* for conducting the investigation, including team work;
· Detailed Analysis/Modeling/Simulation/Design/Problem Solving/Experiment as Needed;
· Final development of product/process, testing, results, conclusions and future Directions;
· Preparing a paper for Conference presentation/Publication in Journals, if possible;
· Preparing a Dissertation in the standard format for being evaluated by the Department;
· Final Seminar Presentation before a Departmental Committee.

Elective Course – I
(DCS051-054)
DIGITAL IMAGE PROCESSING
(DCS051)

Objective: The purpose of this course is to impart knowledge on various Digital Image Processing Techniques and their Applications.

Unit	Topic
I	**Introduction and Fundamentals:** Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization. Image Enhancement in Spatial Domain: Introduction; Basic Gray Level Functions – Piecewise-Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations – Image Subtraction, Image Averaging; Basics of Spatial Filtering; Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.
II	**Image Enhancement in Frequency Domain:** Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Filters – Low-pass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters – Gaussian Low-pass Filters; Sharpening Frequency Domain Filters – Gaussian High-pass Filters; Homomorphic Filtering.
III	**Image Restoration:** A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only-Spatial Filtering – Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering– Band-pass Filters; Minimum Mean-square Error Restoration.
IV	**Color Image Processing:** Color Fundamentals, Color Models, Converting Colors to different models, Color Transformation, Smoothing and Sharpening, Color Segmentation. Morphological Image Processing: Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening.
V	**Image Compression:** Fundamentals, image compression models, Compression methods: Huffman coding, Golomb Coding, Arithmetic Coding, LZW coding, Run-Length coding, Symbol based coding.error-free compression, lossy predictive coding, image compression standards. **Image Segmentation:**Fundamentals, Point, Line and edge detection. Thresholding: foundation, Basic Global Thresholding, Otsu's Method, Image smoothing to improve global thresholding.

References:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Tata McGraw Hill Pvt. Ltd, 2016.
2. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning, 2010 .

AGENT BASED INTELLIGENT SYSTEMS
(DCS052)

Objective: The purpose of this course is to impart knowledge on various Agent Based intelligent systems and their Applications.	
Unit	**Topic**
I	**INTRODUCTION** Definitions - Foundations - History - Intelligent Agents-Problem Solving-Searching - Heuristics -Constraint Satisfaction Problems - Game playing.
II	**KNOWLEDGE REPRESENTATION AND REASONING** Logical Agents-First order logic-First Order Inference-Unification-Chaining- Resolution Strategies Knowledge Representation-Objects-Actions-Events.
III	**PLANNING AGENTS** Planning Problem-State Space Search-Partial Order Planning-Graphs-Nondeterministic Domains Conditional Planning-Continuous Planning-MultiAgent Planning.
IV	**AGENTS AND UNCERTAINITY** Acting under uncertainty – Probability Notation-Bayes Rule and use - Bayesian Networks-Other Approaches-Time and Uncertainty-Temporal Models- Utility Theory - Decision Network – Complex Decisions.
V	**HIGHER LEVEL AGENTS:** Knowledge in Learning-Relevance Information-Statistical Learning Methods-Reinforcement Learning Communication-Formal Grammar-AugmentedGrammars-FutureofAI

References:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence - A Modern Approach”, 2nd Edition, Prentice Hall, 2002
2. Michael Wooldridge, “An Introduction to Multi Agent System”, John Wiley, 2002.
3. Patrick Henry Winston, Artificial Intelligence, III Edition, AW, 1999.
4. Nils.J.Nilsson, Principles of Artificial Intelligence, Narosa Publishing House, 1992.

CLOUD COMPUTING
(DCS053)

Objective: This module gives students the skills and knowledge to understand how Cloud Computing Architecture can enable transformation, business development and agility in an organization. It also provide the concept of cloud security system and cloud infrastructure.

Unit	Topic
I	Introduction - Shift from distributed computing to cloud computing; principles, and characteristics of cloud computing- IaaS, PaaS, SaaS; service oriented computing and cloud environment.
II	Cloud Computing Technology - Client systems, Networks, server systems andsecurity from services perspectives; Accessing the cloud with platforms and applications; cloud storage.
III	Working with Cloud- Infrastructure as a Service – conceptual model and working Platform as a Service – conceptual model and functionalities Software as a Service – conceptual model and working Technologies and Trends in Service provisioning with clouds.
IV	Using Cloud Services- Cloud collaborative applications and services – technology, applications and case studies with calendars, schedulers and event management; cloud applications in project management.
V	Case studies-Microsoft Azure, Google App Engine and Open source clouds-Open-Nebula and Eucalyptus , Current trends and research.

References:

1. Gautam Shroff, Enterprise Cloud Computing Technology Architecture Applications, Cambridge, 2010
2. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach, 2012
3. Dimitris N. Chorafas, Cloud Computing Strategies, 2011.

HUMAN COMPUTER INTERFACE
(DCS054)

Objective: The purpose of this course is the study, planning and design of the interaction between people and computers.	
Unit	**Topic**
I	Introduction: The human, The computer, The interaction, Paradigms, Usability of Interactive Systems, Guidelines, Principles, and Theories.
II	Design Process- Interaction design basics, HCI in the software process, Design rules, Implementation support, Evaluation techniques, Universal design, User support.
III	Models and Theories Cognitive models, Socio-organizational issues and stakeholder requirements, Communication and collaboration models,Task analysis, Dialogue notations and design, Models of the system, Modelling rich interaction.
IV	Interaction Styles- Direct Manipulation and Virtual Environments, Menu Selection, Form Filling and Dialog Boxes, Command and Natural Languages, Interaction Devices, Collaboration and Social Media Participation.
V	Design Issues- Quality of Service, Balancing Function and Fashion, User Documentation and Online Help, Information Search, Information Visualization, Outside the Box- Group ware,Ubiquitous computing and augmented realities, Hypertext, multimedia, and the world wide web.

References:

1,Human Computer Interaction by Alan Dix, Janet Finlay , Pearson Education, 2004.
2. Designing the User Interface - Strategies for Effective Human Computer Interaction, by Ben Shneiderman, Pearson Education, 2001.

Elective Course – II
(DCS061-064)

Robotics
(DCS061)

Objective: The objective of this course is to impart knowledge about industrial robots for their control and design.

Unit	Topic
I	Introduction to Robotics: Types and components of a robot, Classification of robots, closed-loop and openloop control systems, Kinematics systems; Definition of mechanisms and manipulators, Social issues and safety.
II	Robot Kinematics and Dynamics: Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Jacobian, Singularity, and Statics, Dynamic Modelling: Equations of motion: Euler-Lagrange formulation
III	Sensors and Vision System: Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc, Introduction to Cameras, Camera calibration, Geometry of Image formation, Euclidean/Similarity/Affine/Projective transformations, Vision applications in robotics.
IV	Robot Control: Basics of control: Transfer functions, Control laws: P, PD, PID, Non-linear and advanced controls, Robot Actuation Systems: Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators.
V	Control Hardware and Interfacing :Embedded systems: Architecture and integration with sensors, actuators, components, Programming for Robot Applications

References:

1. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.
2. Ghosal, A., "Robotics", Oxford, New Delhi, 2006.
3. Niku Saeed B., "Introduction to Robotics: Analysis, Systems, Applications", PHI, New Delhi.
4. Mittal R.K. and Nagrath I.J., "Robotics and Control", Tata McGraw Hill.
5. Mukherjee S., "Robotics and Automation", Khanna Publishing House, Delhi.
6. Craig, J.J., "Introduction to Robotics: Mechanics and Control", Pearson, New Delhi, 2009

Embedded System
(DCS062)

Objective: To introduce the basic concepts of Embedded Systems and the various techniques used for Embedded Systems with real time examples.	
Unit	**Topic**
I	Hardware Concepts -Application and characteristics of embedded systems, Overview of Processors and hardware Units in an embedded system, General purpose processors, Microcontrollers: 8051.
II	Application- Specific Integrated Circuits (ASICs), ASIP, FPGA, ARM-based System on a Chip (SoC), Network on Chip (NoC), Levels of hardware modelling, Verilog, Sensors, A/D-D/A converters, Actuators, Interfacing using RS-232, UART, USB, I2C, CAN bus, Flexray, SRAM and DRAM, Flash memory.
III	Real-Time Operating Systems- Real-Time Task Scheduling: Some important concepts, Types of real-time tasks and their characteristics, Task scheduling, Clock-Driven scheduling, Hybrid schedulers, Event-Driven scheduling, Earliest Deadline First (EDF) scheduling, Rate monotonic algorithm (RMA).
IV	Commercial Real-time operating systems: Time services, Features of a Real-time operating system, Unix-based Real-time operating systems, POSIX-RT, A survey of contemporary Real- time operating systems, Microkernelbased systems, Benchmarking real-time systems.
V	Embedded Application Development - UML 2.0, State charts, General language characteristics, MISRA C, Hardware/Software Co- design, Hardware/software partitioning, Testing embedded systems, Design for testability and Self-test.

References:

1. Embedded Systems Design – A Unified Hardware /Software Introduction, by Frank Vahid and Tony Givargis, John Wiley.
2. An Embedded Software Primer, by David E.Simon, Pearson Education Asia.

3D Printing and design
(DCS063)

Objective: The course is designed to impart knowledge and skills related to 3D printing technologies, selection of material and equipment and develop a product using this technique in Industry 4.0 environment.	
Unit	**Topic**
I	**3D Printing (Additive Manufacturing):** Introduction, Process, Classification, Advantages, Additive V/s Conventional Manufacturing processes, Applications.
II	**CAD for Additive Manufacturing :** CAD Data formats, Data translation, Data loss, STL format, **Additive Manufacturing Techniques:** Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology, Process, Process parameter, Process Selection for various applications, Additive Manufacturing Application Domains: Aerospace, Electronics, HealthCare, Defense, Automotive, Construction, Food Processing, Machine Tools
III	**Materials:** Polymers, Metals, Non-Metals, Ceramics, Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties, Support Materials
IV	**Additive Manufacturing Equipment:** Process Equipment- Design and process parameters, Governing Bonding Mechanism, Common faults and troubleshooting, Process Design
V	**Post Processing:** Requirement and Techniques **Product Quality:** Inspection and testing, Defects and their causes

References:

1. Lan Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
2. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing”, Hanser Publisher, 2011.
3. Khanna Editorial, “3D Printing and Design”, Khanna Publishing House, Delhi.
4. CK Chua, Kah Fai Leong, “3D Printing and Rapid Prototyping- Principles and Applications”, World Scientific, 2017.
5. J.D. Majumdar and I. Manna, “Laser-Assisted Fabrication of Materials”, Springer Series in Material Science, 2013.
6. L. Lu, J. Fuh and Y.S. Wong, “Laser-Induced Materials and Processes for Rapid Prototyping”, Kulwer Academic Press, 2001.

Virtual Reality
(DCS064)

Objective: The objective of this course is to provide a detailed understanding of the concepts of Virtual Reality and its applications.	
Unit	**Topic**
I	**Introduction to Virtual Reality:** Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark **3D Computer Graphics:** Introduction, The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, 3D clipping, Color theory, Simple 3D modeling, Illumination models, Reflection models, Shading algorithms, Radiosity, Hidden Surface Removal, Realism-Stereographic image.
II	**Geometric Modeling:** Geometric Modeling: Introduction, From 2D to 3D, 3D space curves, 3D boundary representation Geometrical Transformations: Introduction, Frames of reference, Modeling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems.
III	**Virtual Environment:** Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in battening, free from deformation, particle system. **Physical Simulation:** Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.
IV	**VR Hardware and Software:** Human factors: Introduction, the eye, the ear, the somatic senses. VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. VR Software: Introduction, Modeling virtual world, Physical simulation, VR toolkits, Introduction to VRML
V	**VR Applications:** Introduction, Engineering, Entertainment, Science, Training. The Future: Virtual environment, modes of interaction

References:

1. John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2007.
2. Anand R., “Augmented and Virtual Reality”, Khanna Publishing House, Delhi.
3. Adams, “Visualizations of Virtual Reality”, Tata McGraw Hill, 2000.
4. Grigore C. Burdea, Philippe Coiffet , “Virtual Reality Technology”, Wiley Inter Science, 2nd Edition, 2006.
5. William R. Sherman, Alan B. Craig, “Understanding Virtual Reality: Interface, Application and Design”, Morgan Kaufmann, 2008. 5. J.D. Majumdar and I. Manna, “Laser-Assisted Fabrication of Materials”, Springer Series in Material Science, 2013.

Elective Course – III
(DCS065-068)

Distributed System
(DCS065)

Objective: To introduce the fundamentals of distributed computer systems, assuming the availability of facilities for data transmission.

Unit	Topic
I	**Characterization of Distributed Systems.** Examples of distributed systems, Resource sharing on the web, challenges. **System Models:** Introduction, Architectural model fundamental model. **Networking and Internetworking:** Types of network, Network Principles, Internet Protocols**.** Ethernet, WiFi, Bluetooth and ATM.
II	**Interprocess Communication:** API for the internet protocols, External data representation and marshalling, client-server communication, Group communication, Interprocess communication in Unix. **Distributed Objects and Remote Invocation:** Communication between distributed objects, Remote Procedure calls, Events and notifications, Java RMI, Sun network File system.
III	**Operating System Support:** Operating system Layer, Protection, Processes and threads, Communication and Invocation, Operating system Architecture. **Security:** Overview of security techniques, Cryptographic algorithms, Digital signatures, Cryptography pragmatics.
IV	**Time and Global states:** Clocks, events and process states, synchronizing physical clocks, logical time and logical clocks. **Coordination and agreement:** Distributed mutual exclusion, elections, multicast communication, consensus and related problems.
V	**Transactions and concurrency control:** Transactions, Nested transactions, Locks, Optimistic Concurrency control, Timestamp ordering, Comparison of methods for concurrency control. **Distributed Transactions:** Flat and Nested transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery.

References:

1. Distributed Systems, S. Ghosh, Chapman & Hall/CRC, Taylor & Francis Group.
2. Distributed Systems Concepts and Design, G Coulouris, J Dollimore and T Kindberg, Pearson Education

CLUSTER COMPUTING
(DCS066)

Objective: This course teaches solving large-scale science, engineering, and commercial applications.	
Unit	**Topic**
I	Basic concepts in Distributed Systems: Notion of time Distributed Mutual exclusion, Consensus, Failure models Paradigms for process interaction in distributed programs, Programming Paradigms, Shared memory, Message passing, Workflows.
II	Introduction to Cluster Computing, Cluster Middleware: An Introduction, Early Cluster Architecture and High Throughput Computing Clusters, Networking, Protocols and I/O for Clusters, Setting Up and Administering a Cluster.
III	Cluster Technology for High Availability, Performance Models and Simulation, Process Scheduling, Load Sharing and Load Balancing, Distributed Shared Memory.
IV	Introduction to Grid Architecture, Characterization of Grid, and Grid related standard bodies, Grid types, Topologies, Components and Layers, Comparison with other approaches.
V	System Infrastructure, Traditional paradigms for distributed computing, Web Services, Grid standards: OGSA and WSRF, Case Studies of Cluster Systems: Beowulf, COMPaS, NanOS and PARAM.

References:

1. High Performance Cluster Computing: Architectures and Systems, Prentice Hall, 1999.
2. Grid and Cluster Computing, Prabhu C.S.R, PHI Learning Private Limited, 2008.

Block chain
(DCS067)

Objective: The objective of this course is to provide conceptual understanding of how block chain technology can be used to innovate and improve business processes. The course covers the technological underpinning of block Chain operations in both theoretical and practical implementation of solutions using block Chain technology.

Unit	Topic
I	**Introduction:** Overview of Block chain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, Public vs Private Block chain, Understanding Crypto currency to Block chain, Permissioned Model of Block chain, Overview of Security aspects of Block chain **Basic Crypto Primitives:** Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic crypto currency.
II	**Understanding Block chain with Crypto currency:** Bitcoin and Block chain: Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay. Working with Consensus in Bitcoin**:** Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – basic introduction, Hashcash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.
III	**Understanding Block chain for Enterprises:** Permissioned Block chain: Permissioned model and use cases, Design issues for Permissioned block chains, Execute contracts, State machine replication, Overview of Consensus models for permissioned block chain- Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport-Shostak-Pease BFT Algorithm, BFT over Asynchronous systems.
IV	**Enterprise application of Block chain:** Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Block chain, Block chain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, Identity on Block chain
V	**Block chain application development:** Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda

References:

1. Melanie Swan, “Block Chain: Blueprint for a New Economy”, O’Reilly, 2015
2. Daniel Drescher, “Block Chain Basics”, Apress; 1st edition, 2017

PATTERN RECOGNITION
(DCS068)

Objective: To understand the basic building blocks and general principles that allows one to design pattern learning algorithms.

Unit	Topic
I	Basics of pattern recognition, Design principles of pattern recognition system,Learning and adaptation, Pattern recognition approaches, Mathematical foundations – Linear algebra, Probability Theory, Expectation, mean and covariance, Normal distribution, multivariate normal densities, Chi squared test.
II	Statistical Patten Recognition: Bayesian Decision Theory, Classifiers, Normal density anddiscriminant functions.
III	Parameter estimation methods: Maximum-Likelihood estimation, Bayesian Parameterestimation, Dimension reduction methods - Principal Component Analysis (PCA), Fisher Linear discriminant analysis, Expectation-maximization (EM), Hidden Markov Models (HMM), Gaussian mixture models.
IV	Nonparametric Techniques: Density Estimation, Parzen Windows, K-Nearest NeighborEstimation, Nearest Neighbor Rule, Fuzzy classification.
V	Unsupervised Learning & Clustering: Criterion functions for clustering, Clustering Techniques:Iterative square - error partitional clustering – K means, agglomerative hierarchical clustering, Cluster validation.

References:

1. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2009.
2. S. Theodoridis and K. Koutroumbas, “Pattern Recognition”, Academic Press, 2008.

Elective Course – IV
(DCS071-074)

Cryptography and Network Security
(DCS071)

Objective: The objective of this course is to Discover software bugs that pose cyber security threats, explain and recreate exploits of such bugs in realizing a cyber attack on such software, and explain how to fix the bugs to mitigate such threats.	
Unit	**Topic**
I	**Introduction:** Security Goals, Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services and Mechanisms, A model for Internetwork Security, Euclidian Algorithm, Modular operator, Congruence, Additive invers, Multiplicative Inverse, Cryptanalysis, Cipher and Types of Cipher, Substitution Cipher, Caeser Cipher, Affine Cipher, Mono-alphabetic and Polyalphabetic cipher.
II	**Symmetric key and Encryption:** Groups and Applications, Modern Block Ciphers, Component of Modern Bloch Ciphers, D Boxes, Straight D Boxes, Modern Stream ciphers, Encryption, Conventional Encryption Principles & Algorithms, Data Encryption Standard (DES), Des Structure, DES Function, DES Algorithm and key generation, Security of DES, Advanced Encryption Standard(AES), Criteria, Round Data Unit, Algorithm, Analysis of AES,RC4.
III	**Cryptography:** Public key and Private key in Cryptography, Role of public key in cryptography, Cipher, Types of Cipher, Mode of Operation, Cryptography Algorithms (RSA, RABIN, ELGAMAL, Diffie-Hellman, ECC), Key Distribution, Approaches of Message Authentication, Hash Functions in cryptography.
IV	**Email and Web Security:** Pretty Good Privacy (PGP) and S/MIME.IP Security Overview, IP Security Architecture, Authentication Header, Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET).
V	**Network Security**: Intruders, Viruses and related threats, Virus Countermeasures, Firewall Design principles, Trusted Systems, Intrusion Detection Systems.

References:

1. Vincent LeVeque: Information Security: A Strategic Approach, Wiley Publication .
2. Saurabh Sharma: Information Security and cyber Law, Vikas Publication.

REAL TIME SYSTEM
(DCS072)

Objective: Real-time computer systems for the monitoring and control of laboratory and industrial processes are studied and implemented.

Unit	Topic
I	Introduction To Real-Time Computing: Characterizing Real – Time System & Task; Performance Measures of Real Time System, Estimation of Program Run Time, Real- Time System Design: Hardware Requirement, System Development Cycle.
II	Data Transfer Techniques, Synchronous & Asynchronous Data Communication, Standard Interface. Task Assignment And Scheduling: Priority Scheduling, Scheduling with Fixed Priority Dynamic Priority Scheduling.
III	Real-Time Programming Language & Tool: Desired Language Characteristics, Data Typing, Control Structure, Run Time Error- Handling, Overloading & Generics, Runtime Support, Real-Time Databases.
IV	Real-Time Communication Language Algorithm: Fault Tolerance Techniques, Causes of Failure, Fault Type, Fault Detection, Redundancy.
V	Integrated Failure Handling Reliability Evaluation Techniques: Parameter Values, Reliability Model For Hardware Redundancy, Software Error Model and Clock Synchronization.

References:

1. Real Time System: by C.M. Krishna & K.G. Shen- Mc Graw Hill.
2. Real-Time Systems: Design Principles for Distributed Embedded Applications by Kopetz, Hermann, Springer.

GRID COMPUTING
(DCS073)

Objective: The course is project oriented, involving hand-on exploration of existing technologies as well as development of new technologies.

Unit	Topic
I	Overview. Focuses on grid computing as emerging new computing paradigm for solving complex collaborative problems that require massive resources and infinite CPU cycle. The topics included: Definition of Grid; Basic Building Blocks; Issues in Management of Grid Models; Evolution of Grid Models.
II	Architecture. Deals with grid architecture providing an anatomical look into fundamental system components and their functionalities as well as interactions. Topics: Requirements concerning abstractions, behaviours, resources, connectivity, and protocols; Open grid service architectures.
III	Environment. Talks about grid computing environments. Topics: Overview of GCE; Programming models; Middleware for building grid computing environments; Language support (MPI-G, MPI-G2, etc) for grid computing; Meta models for grid programming; Security.
IV	Applications. Deals with case studies, how the global computing infrastructure has become a reality for collaborative complex data intensive computing aid for federated database services, web services, bioinformatics. It will also include among others some selection of topics from Seti project, Sun grid engine, Skyserver and some national grid projects.
V	Monitoring and evaluation. It will include following: Monitoring; Scheduling; Performance tuning; Debugging and performance diagnostic issues.

References:

1. Fundamentals of Grid Computing: Theory, Algorithms and Technologies.
2. Grid Computing by Joshy Joseph, Craig Fellenstein, Prentice Hall Professional.

DATA COMPRESSION
(DCS074)

Objective: To learn the basic concepts of data compressions for compression of text, image, audio, and video for efficient storage and transmission of data over network.	
Unit	**Topic**
I	Mathematical Preliminaries – Information theory, average information content, Entropy. Source models-Physical, probabilistic, Markov, Composite models. Uniquely decodable codes.
II	Huffman coding, arithmetic coding, Dictionary techniques, predictive coding. JPEG-LS, CCITT group 3, 4 recommendations, comparison of MH, MR, MMR, JBIG.
III	Lossy coding – distortion criteria, Human visual system, conditional entropy, average mutual information, differential entropy.
IV	Prediction with Partial Match (ppm) : The Basic Algorithm, The ESCAPE SYMBOL, Length of Context, The Exclusion Principle, The Burrows - Wheeler Transform: Moveto- Front Coding, CALlC, JPEG-LS, Dynamic Markov Compression.
V	Scalar and vector quantization, differential encoding, transforms, sub-band and wavelets, video compression techniques and standards. Performance metrics for compression algorithms.

References:

1. Introduction to Data Compression, Khalid Sayood, Morgan Kaufmann pub.
2. Data Compression, Amrita Jyoti.

MOOC ONLINE COURSE
(OE071-074)

Cyber Law and Ethics

(OE-071)

Objective: The course has been designed to give students an extensive overview of cyber security issues, tools and techniques that are critical in solving problems in cyber security domains.

Unit	Topic
I	**Cyber Security Concepts:** Essential Terminologies: CIA, Risks, Breaches, Threats, Attacks, Exploits. Information Gathering (Social Engineering, Foot Printing & Scanning). Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls.
II	**Infrastructure and Network Security:** Introduction to System Security, Server Security, OS Security, Physical Security, Introduction to Networks, Network packet Sniffing, Network Design Simulation. DOS/ DDOS attacks. Asset Management and Audits, Vulnerabilities and Attacks. Intrusion detection and Prevention Techniques, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.
III	**Cyber Security Vulnerabilities& Safe Guards:** Internet Security, Cloud Computing &Security, Social Network sites security, Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Authorization, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, IT Audit, Authentication. Open Web Application Security Project (OWASP), Web Site Audit and Vulnerabilities assessment.
IV	**Malware:** Explanation of Malware, Types of Malware: Virus, Worms, Trojans, Rootkits, Robots, Adware's, Spywares, Ransom wares, Zombies etc., OS Hardening (Process Management, Memory Management, Task Management, Windows Registry/ services another configuration), Malware Analysis.
V	**Cyber Laws and Forensics:** Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013. Introduction to Cyber Forensics, Need of Cyber Forensics, Cyber Evidence, Documentation and Management of Crime Sense, Image Capturing and its importance, Partial Volume Image, Web Attack Investigations, Denial of Service Investigations, Internet Crime Investigations, Internet Forensics, Steps for Investigating Internet Crime, Email Crime Investigations.

References:

1. William Stallings, "Cryptography and Network Security", Pearson Education/PHI, 2006.
2. Atul Kahate, "Cryptography and Network Security", McGraw Hill.
3. V.K. Pachghare, "Cryptography and Information Security", PHI Learning

Quality Management
(OE072)

Objective: The course has been designed to give students an extensive overview of cyber security issues, tools and techniques that are critical in solving problems in cyber security domains.

Unit	Topic
I	**Introduction to Quality management:** Definitions – TOM framework, benefits, awareness and obstacles. Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.
II	**Quality Management:** Organization structure and design, quality function, decentralization, designing and fitting, organization for different type products and company, economics of quality value and contribution, quality cost, optimizing quality cost, seduction program. Human Factor in quality Attitude of top management, cooperation of groups, operators attitude, responsibility, causes of apparatus error and corrective methods.
III	**Control Charts**: Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts. Attributes of Control Chart, Defects, construction and analysis of charts, improvement by control chart, variable sample size, construction and analysis of C charts.
IV	Defects diagnosis and prevention defect study, identification and analysis of defects, correcting measure, factors affecting reliability, MTTF, calculation of reliability, building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects,
V	Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward- Introduction to software quality.

References:

1. Lt. Gen. H. Lal, "Total Quality Management", Eastern Limited, 1990.
2. Greg Bounds, "Beyond Total Quality Management", McGraw Hill, 1994.
3. Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992

E- Commerce
(OE073)

Objective: To understand the various transactions which can be facilitated through the application of internet technologies.

Unit	Topic
I	Introduction to E-commerce: Definition, features & types, Forces fueling E-commerce, E-Commerce Business Models – B2C, B2B, C2C, M-Commerce, Ethical, social and political issues in e-commerce: privacy and right to information, intellectual property rights.
II	E-Commerce infrastructure: Intranet and Extranet, World Wide Web. Building of e-commerce website: SDLC, build Vs outsource, choosing software, hardware and tools.
III	E-Commerce security: security threats, technology solutions, planning for security. E-Commerce payment systems: digital payment systems, credit cards, e-cash, e-cheques, stored value systems, accumulating balance systems, electronic billing.
IV	E-Commerce marketing: Online consumer behaviour, online marketing technologies, online branding, online customer relationships, online pricing, online market research,
V	E-commerce marketing communication: online advertising, online promotions, costs and benefits of online communications, online marketing communication strategy.

References:

1. E-Commerce, Cutting Edge of Business- Kamlesh K Bajaj, Debjani Nag, Tata McGraw Hill
2. Global Electronic Commerce, Theory and Case Studies J C Westland, T H K Clark- University Press
3. E-Commerce- an Indian perspective, P T Joseph, Prentice Hall
4. E-Commerce concepts, Models, Strategies, C S V Moorthy, Himalaya Publications

DISASTER MANAGEMENT

(OE-074)

Objective: This course objective is to meet the needs of people involved in disaster management for both sudden-onset natural disasters	
Unit	**Topic**
I	**Introduction:** Concepts and definitions: disaster, hazard, vulnerability, risks severity, frequency and details, capacity, impact, prevention, mitigation).
II	**Disasters:** Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.), hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.
III	**Disaster Impacts:** Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.
IV	**Disaster Risk Reduction (DRR):** Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response.
V	**Disasters, Environment and Development:** Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

Text/ Reference Books:

1. Pradeep Sahni, Disaster Risk Reduction in South Asia, Prentice Hall.
2. Singh B.K., Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
3. Ghosh G.K., Disaster Management, APH Publishing Corporation.
4. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214.