

**VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY HYDERABAD**  
**B.TECH. III YEAR**  
**COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)**

**V SEMESTER**

**A19**

| <b>Course Code</b> | <b>Title of the Course</b>                         | <b>L</b>  | <b>T</b> | <b>P</b>  | <b>Contact Hours/Week</b> | <b>Credits</b> |
|--------------------|--|-----------|----------|-----------|---------------------------|----------------|
| A19PC1CS47         | Foundations of Data Science                        | 3         | 0        | 0         | 3                         | 3              |
| A19PC1IT04         | Operating Systems                                  | 3         | 0        | 0         | 3                         | 3              |
| A19PC1CS07         | Computer Networks                                  | 2         | 1        | 0         | 3                         | 3              |
|                    | <b>Professional Elective - I</b>                   |           |          |           |                           |                |
| A19PE1CS46         | Mathematical Modeling for Data Science             | 3         | 0        | 0         | 3                         | 3              |
| A19PE1CS09         | Android Application Development                    |           |          |           |                           |                |
| A19PE1IT03         | Cyber Security                                     |           |          |           |                           |                |
| A19PE1CS62         | Distributed Computing                              |           |          |           |                           |                |
| A19PE1CS31         | Advanced Algorithms                                |           |          |           |                           |                |
|                    | <b>Open Elective - I</b>                           | 3         | 0        | 0         | 3                         | 3              |
| A19PC2CS47         | Foundations of Data Science Laboratory             | 0         | 0        | 3         | 3                         | 1.5            |
| A19PC2CS77         | Operating Systems and Computer Networks Laboratory | 0         | 0        | 3         | 3                         | 1.5            |
| A19PW4CS02         | Internship*  | 0         | 0        | 2         | 2                         | 1              |
| A19PW4CS03         | Design Thinking                                    | 0         | 0        | 4         | 4                         | 2              |
| <b>Total</b>       |  | <b>14</b> | <b>1</b> | <b>12</b> | <b>27</b>                 | <b>21</b>      |

\* Internship to be pursued during summer break after IV semester and evaluated in V semester

## VI SEMESTER

A19

| Course Code  | Title of the Course                              | L         | T        | P        | Contact Hours/Week | Credits   |
|--------------|--|-----------|----------|----------|--------------------|-----------|
| A19PC1CS48   | Big Data Computing                               | 2         | 1        | 0        | 3                  | 3         |
| A19PC1CS09   | Artificial Intelligence                          | 3         | 0        | 0        | 3                  | 3         |
| A19PC1CS08   | Compiler Design                                  | 2         | 1        | 0        | 3                  | 3         |
| A19PC1IT05   | Web Technologies                                 | 2         | 1        | 0        | 3                  | 3         |
|              | <b>Professional Elective - II</b>                |           |          |          |                    |           |
| A19PE1CS48   | Data Science for Engineers                       | 3         | 0        | 0        | 3                  | 3         |
| A19PE1CS06   | Scripting Languages                              |           |          |          |                    |           |
| A19PE1CS08   | Information Security Management                  |           |          |          |                    |           |
| A19PE1CS20   | Cloud Technologies                               |           |          |          |                    |           |
| A19PE1CS14   | Information Retrieval Systems                    |           |          |          |                    |           |
|              | <b>Open Elective - II</b>                        | 3         | 0        | 0        | 3                  | 3         |
| A19PC2CS49   | Big Data Computing Laboratory                    | 0         | 0        | 2        | 2                  | 1         |
| A19PC2IT05   | Web Technologies Laboratory                      | 0         | 0        | 2        | 2                  | 1         |
| A19HS2EN05   | Advanced English Communication Skills Laboratory | 0         | 0        | 2        | 2                  | 1         |
| <b>Total</b> |  | <b>15</b> | <b>3</b> | <b>6</b> | <b>24</b>          | <b>21</b> |
| A19MN6HS03   | Gender Sensitization                             | 2         | 0        | 0        | 2                  | 0         |

L – Lecture

T – Tutorial

P – Practical

**OE TRACKS BASED ON MEZZANINE TECHNOLOGIES:**

| <b>OE TRACKS<br/>(Parent<br/>Department)</b>               | <b>V SEMESTER</b>  | <b>VI SEMESTER</b>  | <b>VII SEMESTER</b>  | <b>VIII SEMESTER</b>   |
|--|--|---|--|--|
| <b>Smart Cities<br/>(CE)</b>                               | Smart Cities Planning and Development<br><b>(A19OE1CE01)</b>   | Green Building Technology<br><b>(A19OE1CE02)</b>                        | Smart Materials and Structures<br><b>(A19OE1CE03)</b>            | Intelligent Transportation System<br><b>(A19OE1CE04)</b>                   |
| <b>Waste Management<br/>(CE)</b>                           | Solid Waste Management<br><b>(A19OE1CE05)</b>  | Hazardous Waste Management<br><b>(A19OE1CE06)</b>                       | Waste to Energy<br><b>(A19OE1CE07)</b>                           | Intelligent Waste Management and Recycling System<br><b>(A19OE1CE08)</b>   |
| <b>Green Energy<br/>(EEE)</b>                              | Renewable Energy Sources<br><b>(A19OE1EE01)</b>  | Renewable Energy Technologies<br><b>(A19OE1EE02)</b>                    | Energy Storage Technologies<br><b>(A19OE1EE03)</b>               | Energy Management and Conservation<br><b>(A19OE1EE04)</b>                  |
| <b>3D Printing &amp; Design<br/>(ME)</b>                   | Elements of CAD<br><b>(A19OE1ME01)</b>   | Introduction to 3D Printing<br><b>(A19OE1ME02)</b>                      | 3D Printing - Machines, Tooling & Systems<br><b>(A19OE1ME03)</b> | Reverse Engineering<br><b>(A19OE1ME04)</b>                                 |
| <b>Internet of Things<br/>(ECE)</b>                        | Sensors Transducers and Actuators<br><b>(A19OE1EC01)</b>   | Introduction to Microcontrollers and Interfacing<br><b>(A19OE1EC02)</b> | Fundamentals of Internet of Things<br><b>(A19OE1EC03)</b>        | Wireless Sensor Networks<br><b>(A19OE1EC08)</b>                            |
| <b>Augmented Reality (AR) / Virtual Reality (VR) (ECE)</b> | Introduction to C Sharp<br><b>(A19OE1EC04)</b>   | Introduction to Signal Processing<br><b>(A19OE1EC05)</b>                | Introduction to Image & Video Processing<br><b>(A19OE1EC06)</b>  | Fundamentals of Augmented Reality & Virtual Reality<br><b>(A19OE1EC07)</b> |
| <b>Artificial Intelligence<br/>(CSE)</b>                   | Mathematics for Artificial Intelligence<br><b>(A19OE1MT01)</b>   | Fundamentals of Artificial Intelligence<br><b>(A19OE1CS01)</b>          | Machine Learning Techniques<br><b>(A19OE1CS02)</b>               | Deep Learning<br><b>(A19OE1CS03)</b>                                       |
| <b>Blockchain Technologies<br/>(CSE)</b>                   | Fundamentals of Computer Networks<br><b>(A19OE1CS04)</b> / Relational Data Base Management Systems <b>(A19OE1CS08)</b> | Distributed Data Bases<br><b>(A19OE1CS05)</b>                           | Cryptography and Network Security<br><b>(A19OE1CS06)</b>         | Blockchain Technology<br><b>(A19OE1CS07)</b>                               |
| <b>Robotics<br/>(EIE)</b>                                  | Fundamentals of Robotics<br><b>(A19OE1EI01)</b>  | Kinematics and Dynamics of Robots<br><b>(A19OE1EI02)</b>                | Drives and Control System for Robotics<br><b>(A19OE1EI03)</b>    | Robot Programming and Intelligent Control Systems<br><b>(A19OE1EI04)</b>   |
| <b>Cyber Security<br/>(IT)</b>                             | Fundamentals of Computer Networks<br><b>(A19OE1CS04)</b> / Relational Data Base Management Systems <b>(A19OE1CS08)</b> | Cryptography and Network Security<br><b>(A19OE1CS06)</b>                | Essentials of Cyber Security<br><b>(A19OE1IT01)</b>              | Computer Forensics<br><b>(A19OE1IT02)</b>                                  |
| <b>Data Sciences / Big Data &amp; Analytics<br/>(IT)</b>   | Statistical Methods for Data Science<br><b>(A19OE1MT02)</b>  | Computational Thinking using Python<br><b>(A19OE1IT03)</b>              | Fundamentals of Data Mining<br><b>(A19OE1IT04)</b>               | Data Analysis and Visualization<br><b>(A19OE1IT05)</b>                     |
| <b>Autonomous Vehicles<br/>(AME)</b>                       | Principles of Automobile Engineering<br><b>(A19OE1AE01)</b>  | Modern Automotive Technologies<br><b>(A19OE1AE02)</b>                   | Electric, Hybrid and Fuel Cell Vehicles<br><b>(A19OE1AE03)</b>   | Connected and Autonomous Vehicles<br><b>(A19OE1AE04)</b>                   |

**GENERAL POOL OF OE COURSES:**

| <b>OE TRACKS<br/>(Parent<br/>Departments)</b> | <b>COURSES</b>  |
|---|---|
| <b>General-<br/>Computing<br/>(CSE / IT)</b>  | <ul style="list-style-type: none"> <li>• Programming through Java <b>(A19OE1IT06)</b></li> <li>• Relational Data Base Management Systems <b>(A19OE1CS08)</b></li> <li>• Computational Thinking using Python <b>(A19OE1IT03)</b></li> <li>• Introduction to Data Analytics <b>(A19OE1IT07)</b></li> <li>• Fundamentals of Computer Algorithms <b>(A19OE1CS11)</b></li> </ul>   |
| <b>General<br/>(H&amp;S)</b>                  | <ul style="list-style-type: none"> <li>• Professional Ethics &amp; Human Values <b>(A19OE1HS01)</b></li> <li>• Entrepreneurship <b>(A19OE1HS02)</b></li> <li>• Personality Development and Public Speaking <b>(A19OE1HS03)</b></li> <li>• Foreign Language-French <b>(A19OE1HS04)</b></li> </ul>  |
| <b>General</b>                                | <ul style="list-style-type: none"> <li>• Smart Cities <b>(A19OE1CE09)</b></li> <li>• Trends in Energy Sources for Sustainable Development <b>(A19OE1EE05)</b></li> <li>• 3D Printing and Design <b>(A19OE1ME05)</b></li> <li>• Embedded Systems for IoT <b>(A19OE1EC09)</b></li> <li>• Artificial Intelligence - A Beginner's Guide <b>(A19OE1CS09)</b></li> <li>• Blockchain Technology Essentials <b>(A19OE1CS10)</b></li> <li>• Fundamentals of Robotics and Drones <b>(A19OE1EI05)</b></li> <li>• Fundamentals of Cyber Security <b>(A19OE1IT08)</b></li> <li>• Fundamentals of Data Science <b>(A19OE1IT09)</b></li> <li>• Introduction to Advanced Vehicle Technologies <b>(A19OE1AE05)</b></li> <li>• Introduction to Application Development with C# <b>(A19OE1CS12)</b></li> <li>• Introduction to Application Development with Java <b>(A19OE1CS13)</b></li> <li>• Introduction to Application Development with Python <b>(A19OE1CS14)</b></li> </ul> |

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B.Tech. V Semester

| L | T/P/D | C |
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(A19PC1CS47) FOUNDATIONS OF DATA SCIENCE

**COURSE OBJECTIVES:**

- To obtain a comprehensive knowledge of various tools and techniques for data science
- To analyze the various probability distributions
- To provide advanced statistical background for analyzing data and drawing inferences from the analysis
- To learn the basic statistics, data visualization and SVM for specific problems and issues

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Explain Data Science, basics of the Python, and various distributions

**CO-2:** Calculate and interpret descriptive statistics appropriately

**CO-3:** Device visualization of real time data and analyzing SVM's

**CO-4:** Apply visualization techniques for various data analysis tasks

**UNIT – I:**

**Introduction to Core Concepts and Technologies:** What is Data Science? NumPy Basics, NumPy Broadcasting, Pandas, Data Frame Creation, Types of Data, Populations and Samples, Probability Distributions and Example Applications, Cumulative Distribution Function, Normal Distribution, Standard Normal Distribution, Empirical Rule, and Related Problems, Assessing Normality.

**UNIT – II:**

**Distributions:** Binomial Distribution, Poisson Distribution, Hyper geometric distribution, discrete uniform distribution, exponential distribution, lognormal distribution, K-S Test for similarity of two distributions, power law and pareto distribution, box-cox transform, Interpretation of Chebyshev's inequality.

**UNIT – III:**

**Exploration to Statistics:** Inference for a single proportion, Difference of two proportions; testing for goodness of fit using chi-square. One-sample means with the t-distribution, Paired data, Difference of two means, Power calculations for a difference of means, comparing many means with Analysis of variance (ANOVA).

**UNIT – IV:**

**Data Visualization:** Show(), grid(), xlim(), ylim(), subplots, scatterplot, histogram, bar plot, study of seaborn library, kde, count plot, box plot, whisker plot(), pairwise plot, violin plot, different types of grids, palette in seaborn.

**UNIT – V:**

**Statistics:** Descriptive Statistics, Central Tendency, calculating skewness with a data set, skewness of a distribution, kurtosis, calculating kurtosis with a data set, variance and standard deviation, univariate, bivariate and multivariate statistics.

**UNIT – VI:**

**Support Vector Machines (SVM):** Geometric Intuition of SVM, Mathematical formulation of SVM, Loss function-based interpretation of SVM, dual form of SVM formulation, kernel trick, polynomial kernel, RBF kernel, Domain Specific Kernels, SVM Regression, code sample, hard margin SVM, soft margin SVM.

**TEXTBOOKS:**

1. Probability and Mathematical Statistics, Prasanna Sahoo, 2008
2. Interactive Data Visualization: Foundations, Techniques, and Applications, Natick, Ward, Grinstein Keim, A. K. Peters Ltd.
3. Introduction to Information Retrieval, Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Cambridge University Press, 2008

**REFERENCES:**

1. Guide to NumPy, Travis E. Oliphant, 2<sup>nd</sup> Edition, MIT, 2006
2. Computational and Inferential Thinking: The Foundations of Data Science, Adi Adhikari and John De Nero, 1<sup>st</sup> Edition, 2019
3. Doing Data Science, Straight Talk from The Frontline, Cathy O'Neil and Rachel Schutt, O'Reilly, 2014
4. Interactive Data Visualization: Foundations, Techniques, and Applications, Natick, Ward, Grinstein Keim, A. K. Peters Ltd.
5. Machine Learning, Tom M. Mitchell, McGraw-Hill

## VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

B.Tech. V Semester

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### (A19PC1IT04) OPERATING SYSTEMS

#### COURSE OBJECTIVES:

- To study the basic concepts and functions of operating systems
- To summarize various approaches to solve the problem of process concurrency in an operating system
- To evaluate the memory usage trade-offs in terms of size (main memory, auxiliary memory) and processor speed
- To understand disk storage strategies and file strategies with protection and security issues

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Identify System calls and evaluate process scheduling criteria of OS

**CO-2:** Develop procedures for process synchronization and scheduling services of an OS

**CO-3:** Distinguish disk access, file systems supported by an OS

**CO-4:** Extend operating systems virtual memory, protection and security aspects

#### UNIT – I:

**Computer System and Operating System Overview:** Overview of Computer System hardware, Operating System Objectives and functions Operating System Services, System Calls, System Programs.

**CPU Scheduling:** Basic Concepts, Scheduling Criteria, Scheduling Algorithms and evaluation.

#### UNIT – II:

**Linux Utilities:** File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking commands, Filters, Text processing utilities and Backup utilities, sed – scripts, operation, addresses, commands, applications, awk – execution, fields and records, scripts are using system commands in awk.

#### UNIT – III:

**Process Management:** Process Description, Process Control Block, Process States, Threads Overview.

**Concurrency:** Cooperating Processes, Inter-process Communication, Principles of Concurrency, Mutual Exclusion, Software and hardware approaches, Semaphores, Monitors, Message Passing, Classic problems of synchronization.

**Inter Process Communication:** Introduction to IPC, Pipes, and FIFOs, Introduction to three types of IPC-message queues, semaphores and shared memory. Message Queues Kernel support for messages, client/server example.

#### UNIT – IV:

**Principles of Deadlock:** System Model, Deadlock Characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock avoidance, Deadlock detection, Recovery from Deadlocks, Dining philosopher's problem.

**UNIT-V:**

**Memory Management:** Basic concepts, Swapping, Contiguous memory allocation, Paging, Segmentation, Virtual memory, Demand paging, Page-replacement algorithms, Thrashing.

**Secondary Storage Structure:** Disk structure; Disk scheduling, Disk management, Swap space Management, RAID structure, Stable-storage Implementation

**Case Studies:** windows, Unix, Linux.

**UNIT –VI:**

**File Management:** File system-File concepts, File System Structure, Inodes, File Attributes, File types, Access methods, Symbolic links & hard links, Directory structure, Filesystem mounting, Implementing file systems-File system structure and implementation, Directory implementation, Allocation methods, Free-space management, Efficiency and performance

**Protection & Security:** Protection mechanisms, OS Security issues, threats, Intruders, Viruses,

**Case Studies:** windows, Unix, Linux.

**TEXT BOOKS:**

1. Operating System Principles, Abraham Silberchatz, Peter B. Galvin, Greg Gagne, 7<sup>th</sup> Edition, John Wiley
2. Unix Concepts and Applications, Sumitabha Das, 4<sup>th</sup> Edition, TMH, 2006

**REFERENCES:**

1. Modern Operating Systems, Andrew S. Tanenbaum, 2<sup>nd</sup> Edition, Pearson/PHI
2. Operating Systems – A Concept Based Approach, D. M. Dhamdhare, 2<sup>nd</sup> Edition
3. Unix System Programming using C++, T. Chan, PHI
4. Operating Systems - Internal and Design Principles, Stallings, 5<sup>th</sup> Edition, Pearson Education/PHI, 2005



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|---|-------|---|
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(A19PC1CS07) COMPUTER NETWORKS

**COURSE OBJECTIVES:**

- To develop an understanding of modern network architectures from a design and performance perspective
- To introduce the student to the major concepts, principles involved in data link layer and network layer
- To provide an opportunity to learn how to maintain QoS in network & maintaining of congestion control
- To get an idea of application layer functionalities and importance of security in the network

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand modern network architectures from a design and performance perspective

**CO-2:** Learn major concepts, principals involved in Data Link Layer and Network Layer

**CO-3:** Analyze how to maintain QoS in Network and maintaining of Congestion Control

**CO-4:** Get an idea of Application Layer functionalities and importance of Security in the Network

**UNIT – I:**

**Data Communication Components:** Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, Overview of LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Band width utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

**UNIT – II:**

**Data Link Layer and Medium Access Sub Layer:** Error Detection and Error Correction -Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA

**UNIT – III:**

**Network Layer:** Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP-Delivery, Forwarding and Unicast Routing protocols.

**UNIT – IV:**

**Transport Layer:** Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

**UNIT – V:**

**Application Layer:** Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Firewalls.

**UNIT – VI:**

**Security:** Cryptography- Symmetric-Key Cryptography, Asymmetric-Key Cryptography, Network Security- Security Services, Message Confidentiality, Message Integrity, Message Authentication, Digital Signature, Entity Authentication, Key Management.

**TEXT BOOKS:**

1. Data Communication and Networking, Behrouz A. Forouzan, 4<sup>th</sup> Edition, Tata McGraw-Hill
2. Computer Networks, Andrew S. Tanenbaum, 8<sup>th</sup> Edition, Pearson New International Edition

**REFERENCES:**

1. Data and Computer Communication, William Stallings, 8<sup>th</sup> Edition, Pearson Prentice Hall
2. Internetworking with TCP/IP, Volume 1, Douglas Comer, 6<sup>th</sup> Edition, Prentice Hall
3. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley

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(A19PE1CS46) MATHEMATICAL MODELING FOR DATA SCIENCE

**COURSE OBJECTIVES:**

- To introduce the various mathematical concepts and models
- To undertake a critical evaluation of a wide range of data
- To develop designing skills for modeling non-deterministic problems
- To demonstrate various machine learning algorithms used in data process

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand basic mathematical concepts in data science like linear algebra, probability and optimization

**CO-2:** Apply linear models for regression and linear models for classification

**CO-3:** Employ hypothesis testing and confidence interval for several real time problems

**CO-4:** Conceptualize problems related to regression and hypothesis testing

**UNIT – I:**

**Linear Algebra:** Matrices, solving linear equations, vector spaces, linear independence, basis and rank, linear mappings, norms, inner products, orthogonality, orthonormal basis, inner product of functions, orthogonal projections. Introduction to Vectors (2-D, 3-D, n-D): Row Vector, Column Vector, Dot Product, Angle between two vectors, Projection, and unit vector.

**UNIT – II:**

**Optimization:** Equation of a line(2-D), Plane(3-D) and Hyper Plane(n-D). Three pillars of data science, Fundamentals of optimization. What is optimization, components of optimization problem, types of optimization problems, univariate optimization and related numerical examples, multivariate optimization and related numerical examples.

**UNIT – III:**

**Naive Bayes Classification:** Conditional probability, example of condition probability, independent events, mutually exclusive events, bayes theorem and related problems, Naive Bayes algorithm and its mathematical interpretation, problem on Naive Bayes algorithm. Feature importance and interpretability. Imbalanced data, outliers in Naive Bayes, multiclass classification.

**UNIT – IV:**

**Model Building:** Correlation: Pearson's correlation, Kendall rank correlation, spearman rank correlation, Regression, and its basics. Types of regression, fitting a function-criterion for best fit, least squares, simple regression, model assessment and validation, regression analysis, regression process.

**UNIT – V:**

**Regression:** Empirical model, Geometrical interpretation of linear regression, residual plots, normal probability plot, multiple regression, maximum likelihood estimation, logistic regression, linear regression vs logistic regression.

**UNIT – VI:**

**Hypothesis Testing:** Estimator, Confidence Interval, Point Estimate, Interval Estimate, Unbiasedness, confidence level, Margin Error

Null Hypothesis, Alternative Hypothesis, Examples of Hypothesis Testing, Types of errors in hypothesis testing, P value approach in hypothesis testing, Critical value approach in hypothesis testing, Hypothesis testing F-Test, Z-Test, T-Test.

**TEXTBOOKS:**

1. Mathematics for Machine Learning, Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong, Cambridge University Press, 2020
2. Linear Algebra Done Right, S. Axler, Springer, 2017
3. Linear Algebra and Optimization for Machine Learning, Charu C. Aggarwal, Springer

**REFERENCES:**

1. Mathematical Foundations of Data Science Using R, Matthias Dehmer, Salissou Moutari, Frank Emmert-Streib, De Gruyter Oldenbourg, 2020
2. Probability and Statistics for Data Science: Math + R + Data, Norman Matloff, CRC Data Science Series, 2019
3. Matrix Methods In Data Mining and Pattern Recognition, Society for Industrial and Applied Mathematics, Eldén Lars, 2007
4. Linear Algebra and Probability for Computer Science Applications, E. Davis, CRC Press, 2012

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### (A19PE1CS09) ANDROID APPLICATION DEVELOPMENT

#### COURSE OBJECTIVES:

- To describe the essentials of mobile apps development
- To examine and illustrate J2ME, Android and SQLite databases in relevance to Mobile applications
- To understand how Android applications work, manifest, Intents, and using external resources
- To learn to develop applications for current and emerging mobile computing devices

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Describe the mobility landscape

**CO-2:** Identify mobile apps development aspects

**CO-3:** Design and develop mobile apps, using Android as development platform, with key focus on user experience design, native data handling and background tasks and notifications

**CO-4:** Summarize and compose testing, signing, packaging and distribution of mobile apps

#### UNIT – I:

**Introduction to Mobile:** A brief history of Mobile, The Mobile Ecosystem, Why Mobile?, Types of Mobile Applications, Mobile Information Architecture, Mobile Design, Mobile 2.0, Mobile Web development, Small Computing Device Requirements.

#### UNIT – II:

**Introduction to Android:** History of Mobile Software Development, The Open Handset Alliance, Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – User interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.

#### UNIT – III:

**Introduction to Android SDK:** The Android Platform, Android SDK, Eclipse Installation, Android Installation, installation of Android Studio, working with android studio, Building a Sample Android application.

#### UNIT – IV:

**Android Application Design Essentials:** Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions, Managing Application resources in a hierarchy, Working with different types of resources

**UNIT – V:**

**Android User Interface Design:** Essentials User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation, Using Android Data and Storage APIs, Sharing Data between Applications with Content Providers, managing data using SQLite.

**UNIT – VI:**

**Using Common Android APIs:** Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World. Packaging and deployment – Interaction with server-side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.

**TEXT BOOKS:**

1. Android Wireless Application Development, Lauren Darcey and Shane Conder, Pearson Education, 2<sup>nd</sup> Edition, 2011
2. Mobile Design and Development, Brian Fling, 1<sup>st</sup> Edition, O'Reilly, 2009
3. Professional Android 2 Application Development, Reto Meier, Wiley India

**REFERENCES:**

1. Beginning Android, Mark L. Murphy, Wiley India
2. Pro Android, Sayed Y. Hashimi and Satya Komatineni, Wiley India
3. Teach Yourself Android Application Development in 24 Hours, 1<sup>st</sup> Edition, SAMS

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### (A19PE1IT03) CYBER SECURITY

**COURSE PRE-REQUISITES:** Basic knowledge of Computers, Basic knowledge of Networking and Internet, Hands-on Windows Operating System

#### **COURSE OBJECTIVES:**

- To identify the key components of cyber security in network
- To describe the techniques in protecting Information security
- To define types of analyzing and monitoring potential threats and attacks
- To access additional external resources to supplement knowledge of cyber forensics and laws

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand, appreciate, employ, design and implement appropriate security technologies

**CO-2:** Demonstrate policies to protect computers and digital information

**CO-3:** Identify & Evaluate Information Security threats and vulnerabilities in Information Systems

**CO-4:** Understanding computer forensics and cyber laws and analyzing them

#### **UNIT – I:**

**Introduction to Cyber Crime:** Introduction Cybercrime: Definition and Origins of the word, Cybercrime and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, E-mail Spoofing, Spamming, Cyber defamation, Internet Time Theft, Salami Attack/ Salami Technique, Data Diddling, Forgery, Web Jacking, Newsgroup Spam/ Crimes Emanating from Usenet Newsgroup, Industrial Spying/Industrial Espionage, Hacking, Online Frauds, Pornographic Offenses, Software Piracy, Computer Sabotage, EMail Bombing/Mail Bombs, Usenet Newsgroup as the Source of Cybercrimes, Computer Network Intrusions, Password Sniffing, Credit Card Frauds, Identity Theft.

#### **UNIT – II:**

##### **Cyber Offenses:**

**How Criminals Plan Them:** Introduction, Categories of Cybercrime, How Criminals Plan the Attacks, Reconnaissance, Passive Attacks, Active Attacks, Scamming and Scrutinizing Gathered Information, Attack (Gaining and Maintaining the System Access), Social Engineering, Classification of Social Engineering, Cyber stalking, Types of Stalkers, Cases Reported on Cyber stalking, How Stalking Works?, Real-Life Incident of Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The fuel for Cybercrime, Botnet, Attack Vector, Cloud Computing, Why Cloud Computing?, Types of Services, Cybercrime and Cloud Computing.

#### **UNIT – III:**

**Tools and Methods Used In Cyber Crime:** Introduction, Proxy Servers and Anonymizers, Phishing, How Phishing Works, Password Cracking, Online Attacks, Offline Attacks, Strong, Weak and Random Passwords, Random Passwords, Keyloggers and Spywares, Software Keyloggers, Hardware Keyloggers,

Antikeylogger, Spywares, Virus and Worms, Types of Viruses, Trojan Horses and Backdoors, Backdoor, How to Protect from Trojan and Backdoors, Steganography, Steganalysis, Dos and Ddos Attacks, Dos Attacks, Classification of Dos Attacks, Types of Levels of Dos Attack, Tools Used to Launch Dos Attacks, Ddos Attacks, How to protect from Dos/Ddos Attacks, SQL Injection, Steps for SQL Injection Attack, How to Prevent SQL Injection Attacks.

#### **UNIT – IV:**

**Understanding Computer Forensics:** Introduction, Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, The Rules of Evidence, Forensics Analysis of E-Mail, RFC2822, Digital Forensics Life Cycle, The Digital Forensics Process, The Phases in Computer Forensics/Digital Forensics, Precautions to be Taken when Collecting Electronic Evidence, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Typical Elements Addressed in a Forensics Investigation Engagement Contract , Solving a Computer Forensics Case, Computer Forensics and Steganography, Rootkits, Information Hiding, Forensics and Social Networking Sites: The Security/Privacy Threats, Challenges in Computer Forensics, Technical Challenges: Understanding the Raw Data and its Structure, The Legal Challenges in Computer Forensics and Data Privacy Issues, Special Tools and Techniques, Digital Forensics Tools Ready Reckoner, Special Technique: Data Mining used in Cyber forensics, Forensics Auditing.

#### **UNIT – V:**

##### **Cybercrime and Cyberterrorism:**

**Social, Political, Ethical and Psychological Dimensions:** Introduction, Intellectual Property in the Cyberspace, Copyright, Patent, Trademarks, Trade Secret, Trade Name, Domain Name, The Ethical Dimension of Cybercrimes, Ethical Hackers: Good Guys in Bad Land, The Psychology, Mindset and Skills of Hackers and Other Cybercriminals, Inside the Minds and Shoes of Hackers and Cybercriminals, Hackers and Cybercriminals: Evolution of Technical prowess and Skills, Ethical Hackers, Sociology of Cybercriminals, Personality Traits of Cybercriminals and Younger Generation's views about Hacking, Information Warfare: Perception or An Eminent Reality?, Cyberwar Ground is HOT, Cyber Jihadist on the Rise

#### **UNIT – VI:**

**Fundamentals of Cyber Law:** Evolution of the IT Act, Genesis and Necessity , Salient features of the IT Act, 2000, various authorities under IT Act and their powers, Penalties & Offences, amendments, Impact on other related Acts Cyber Space Jurisdiction - Jurisdiction issues under IT Act, 2000- Traditional principals of Jurisdiction - Extra-terrestrial Jurisdiction- Case Laws on Cyber Space Jurisdiction Sensitive Personal Data or Information (SPDI) in Cyber Law (a) SPDI Definition and Reasonable Security Practices in India (b) Reasonable Security Practices – International perspective.

#### **TEXT BOOKS:**

1. Cyber Security - Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunit Belpure, Wiley
2. Cyber Law & Cyber Crimes, Advocate Prashant Mali, Snow White Publications



**REFERENCES:**

1. Management of Information Security, M. E. Whitman, H. J. Mattford, Nelson Education, 3<sup>rd</sup> Edition, Cengage Learning, 2011
2. Guide to Computer Forensics and Investigations, B. Nelson, A. Phillips, F. Enfinger, C. Steuart, 4<sup>th</sup> Edition, Nelson Education / Cengage Learning, 2010
3. Cyber Law in India, Farooq Ahmad, Pioneer Books
4. Information Technology Law and Practice, Vakul Sharma, Universal Law Publishing

**(A19PE1CS62) DISTRIBUTED COMPUTING**

**COURSE OBJECTIVES:**

- To know exclusion algorithms, deadlock detection algorithms and agreement protocols
- To gain insight on to the distributed resource management components viz. the algorithms
- To implement atomic transactions, recovery and commit protocols
- To know the components and management aspects of grid computing and cluster computing

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand the various synchronization, scheduling and memory management issues

**CO-2:** Apply the mutual exclusion, deadlock detection and agreement protocols of distributed operating system

**CO-3:** Analyze the various resource management techniques for distributed computing

**CO-4:** Evaluate the different features of grid computing and cluster computing

**UNIT – I:**

**Introduction:** The different forms of computing - Monolith Distributed, Parallel and cooperative computing, the meaning of Distributed computing, Examples of Distributed systems, the strengths and weaknesses of Distributed computing operating system concepts relevant to distributed computing, the architecture of distributed applications.

**UNIT – II:**

**Distributed Computing Paradigms:** Paradigms for Distributed Applications - Message Passing Paradigm, The Client-Server Paradigm (Java Socket API), The peer-to-peer Paradigm, Message system (or MOM) Paradigm - the point-to-point message model and the publish/subscribe message model, RPC model, The Distributed Objects Paradigms - RMI ORB, the object space Paradigm, The Mobile Agent Paradigm.

**UNIT – III:**

**Distributed Objects Paradigm (RMI):** Message passing versus Distributed Objects, An Archetypal Distributed Object Architecture, Distributed Object Systems, RPC, RMI, The Java RMI Architecture, Java RMI API, A sample RMI Application, steps for building an RMJ application, testing and debugging, comparison of RMI and socket API

**UNIT – IV:**

**Distributed Object Paradigm (CORBA):** The basic Architecture, The CORBA object interface, Inter-ORB protocols, object servers and object clients CORBA object references, CORBA Naming Service and the Interoperable Naming Service, CORBA object services, object Adapters, Java IDL, An example CORBA application.

#### **UNIT – V:**

**Mutual Exclusion:** A centralized algorithm, distributed algorithm, token ring algorithm, election algorithms, the bully algorithm, a ring algorithm, Atomic Transactions: Introduction, transaction model, transaction primitives, Properties of transactions, nested transactions, twophase commit protocol  
**Concurrency Control:** Locking, optimistic concurrency control, timestamps, Deadlocks in Distributed Systems: Distributed deadlock detection, centralized deadlock detection, distributed deadlock prevention

#### **UNIT – VI:**

**Grid Computing:** Definition of grid, grid types - computational grid, data grid, grid benefits and applications, drawbacks of grid computing, grid components, grid architecture and its relation to various Distributed Technologies.

**Cluster Computing:** Parallel computing overview, cluster computing - Introduction, Cluster Architecture, parallel programming models and Paradigms, Applications of Clusters.

#### **TEXTBOOKS:**

1. Distributed Computing, Principles and Applications, M. L. Liu, Pearson Education
2. Distributed Systems, Principles and Paradigms, A. S. Tanenbaum and M. V. Steen, Pearson Education
3. Client/Server Programming with Java and CORBA, R. Orfali & Dan I. larkey, Second Edition, John Wiley & Sons

#### **REFERENCES:**

1. A Networking Approach to Grid Computing, D. Minoli, Wiley & Sons
2. Grid Computing: A Practical Guide to Technology and Applications, A. Abbas, Firewall Media
3. Grid Computing, J. Joseph & C. Fellenstein, Pearson Education
4. Distributed Systems, Concepts and Design, G. Coulouris, J. Dollimore and Tim Kindberg, 3<sup>rd</sup> Edition, Pearson Education
5. High Performance Cluster Computing, Rajkumar Buyya, Pearson Education

## VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

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### (A19PE1CS31) ADVANCED ALGORITHMS

#### COURSE OBJECTIVES:

- To introduce students to the advanced methods of designing and analyzing algorithms on matrix operations and matroids
- To choose appropriate algorithms and use it for flow-networks problems and graph shortest path problems
- To understand different linear programming and approximation problem solving techniques.
- To familiarize with basic paradigms used to solve probabilistic, randomized and number-theoretic algorithms

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand algorithmic strategies on matrix operations and matroids

**CO-2:** Evaluate the complexity of different flow-networks and graph shortest path problems

**CO-3:** Analyze linear programming and approximation algorithms

**CO-4:** Insight in the field of the probabilistic, randomized and number-theoretic algorithms

#### UNIT – I:

Overview of Divide and Conquer, Greedy and Dynamic Programming strategies. Basic search and traversal techniques for graphs, Backtracking, Branch and Bound.

**Matrix Computations:** Solving systems of linear equations, Inverting matrices, Symmetric positive-definite matrices and least-squares approximation.

#### UNIT – II:

**Matroids:** An activity-selection problem, Elements of the greedy strategy, Matroids and greedy methods, A task-scheduling problem as a matroid.

**Flow-Networks:** Flow networks, The Ford-Fulkerson method, Maximum bipartite matching, Push-relabel algorithms, The relabel-to-front algorithm.

#### UNIT – III:

**Shortest Path in Graphs:** Single-source shortest paths in directed acyclic graphs, Shortest paths and matrix multiplication, The Floyd-Warshall algorithm, Johnson's algorithm for sparse graphs.

**Linear Programming:** Formulating problems as linear programs, Simplex algorithm.

#### UNIT – IV:

**Approximation Algorithms:** The vertex-cover problem, The traveling-salesman problem, The set-covering problem, Randomization and linear programming, The subset-sum problem.

#### UNIT – V:

**Probabilistic Algorithms & Randomized Algorithms:** The hiring problem, Indicator random variables, Randomized algorithms, Probabilistic analysis and further uses of indicator random variables.

**UNIT – VI:**

**Number-Theoretic Algorithms:** Elementary number-theoretic notions, Greatest common divisor, Modular arithmetic, Solving modular linear equations, The Chinese remainder theorem, Powers of an element The RSA public-key cryptosystem.

**TEXTBOOKS:**

1. Introduction to Algorithms, Cormen, Leiserson, Rivest, Stein
2. Fundamentals of Computer Algorithms, E. Horowitz, S. Salmi, S. Rajasekaran, 2<sup>nd</sup> Edition, University Press, 2007

**REFERENCES:**

1. The Design and Analysis of Computer Algorithms, Aho, Hopcroft, Ullman
2. Algorithm Design, Kleinberg and Tardos
3. Design analysis and Algorithms, Hari Mohan Pandey, University Science Press, 2009
4. Algorithm Design – Foundations, Analysis, and Internet Algorithms, M. T. Goodrich, R. Tomassia, John Wiley, 2002

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### (A19PC2CS47) FOUNDATIONS OF DATA SCIENCE LABORATORY

#### COURSE OBJECTIVES:

- To introduce visual perception and core skills for visual analysis
- To develop skills to both design and critique visualizations
- To obtain a comprehensive knowledge of various tools and techniques for data science
- To analyze the various methods of data collection

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand the basic concepts of Numpy and Pandas

**CO-2:** Apply and interpret fundamental concepts of data science

**CO-3:** Explore the basics of data visualization

**CO-4:** Implementation of advanced data visualization

#### WEEK 1 & 2:

1. Create NumPy arrays from Python Data Structures, Intrinsic NumPy objects and Random Functions.
2. Manipulation of NumPy arrays- Indexing, Slicing, Reshaping, Joining and Splitting.
3. Computation on NumPy arrays using Universal Functions and Mathematical methods.
4. Import a CSV file and perform various Statistical and Comparison operations on rows/columns.
5. Load an image file and do crop and flip operation using NumPy Indexing.

#### WEEK 3, 4, 5 & 6:

1. Create Pandas Series and Data Frame from various inputs.
2. Import any CSV file to Pandas Data Frame and perform the following:
  - (a) Visualize the first and last 10 records.
  - (b) Get the shape, index and column details.
  - (c) Select/Delete the records(rows)/columns based on conditions.
  - (d) Perform ranking and sorting operations.
  - (e) Do required statistical operations on the given columns.
  - (f) Find the count and uniqueness of the given categorical values.
  - (g) Rename single/multiple columns.

#### WEEK 7, 8, 9 & 10:

1. Import any CSV file to Pandas Data Frame and perform the following:
  - (a) Handle missing data by detecting and dropping/ filling missing values.
  - (b) Transform data using apply () and map() method.
  - (c) Detect and filter outliers.
  - (d) Perform Vectorized String operations on Pandas Series.
2. Implement regularized Linear regression.

#### WEEK 11, 12, 13 & 14:

1. Visualize data using Line Plots, Bar Plots, Histograms, Density Plots and Scatter Plots.
2. Download the House Pricing dataset from Kaggle and map the values to

Aesthetics.

3. Use different Color scales on the Rainfall Prediction dataset.
4. Create different Bar plots for variables in any dataset.
5. Show an example of Skewed data and removal of skewedness.
6. For a sales dataset do a Time Series visualization.
7. Build a Scatterplot and suggest dimension reduction.

#### **WEEK 15:**

LAB INTERNAL.

#### **TEXTBOOKS:**

1. Computational and Inferential Thinking: The Foundations of Data Science, Adi Adhikari and John De Nero, 1<sup>st</sup> Edition, 2019
2. Doing Data Science, Straight Talk from The Frontline, Cathy O'Neil and Rachel Schutt, O'Reilly, 2014
3. Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures, Claus Wilke, 1<sup>st</sup> Edition, O'Reilly Media, 2019

#### **REFERENCES:**

1. Mining of Massive Datasets, v2.1, Jure Leskovek, Anand Rajaraman and Jeffrey Ullman, Cambridge University Press, 2014
2. Practical Statistics for Data Scientists: 50 Essential Concepts, Bruce, Peter, and Andrew Bruce, O'Reilly Media, 2017
3. Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems, Ossama Embarak, Press, 2018

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**(A19PC2CS77) OPERATING SYSTEMS AND COMPUTER NETWORKS LABORATORY**

**COURSE OBJECTIVES:**

- To explore operating system processor scheduling and deadlock mitigation techniques
- To analyze various file, disk and memory management mechanisms
- To learn and understand various error correction and detection mechanisms
- To examine basic networking commands and networking algorithms

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Implement various processor and memory scheduling algorithms

**CO-2:** Design and implement disk access, file systems facilities of OS

**CO-3:** Implement error correction and error detection mechanisms

**CO-4:** Acquire the required skill to design simple computer networks

**LIST OF EXPERIMENTS:**

**OPERATING SYSTEMS PROGRAMS:**

**WEEK 1:**

Simulate the following CPU scheduling algorithms  
Round Robin b) SJF c) FCFS d) Priority based algorithm

**WEEK 2:**

Simulate the following algorithms  
a) Best fit b) worst fit c) first fit

**WEEK 3:**

Simulate the following file allocation strategies  
a) Sequential b) Indexed c) Linked

**WEEK 4:**

Simulate algorithms for deadlock avoidance and deadlock detection

**WEEK 5:**

Simulate the following page replacement algorithms  
a) FIFO b) Optimal c) LRU

**WEEK 6:**

Simulate the following disk scheduling algorithm  
a) SCAN b) CSCAN c) LOOK

**WEEK 7:**

Lab internal



## **COMPUTER NETWORKS PROGRAMS:**

### **WEEK 1:**

Implement the data link layer framing methods such as character, character stuffing and bit stuffing.

### **WEEK 2:**

Implement on a data set of characters the three CRC polynomials – CRC 12, CRC 16 and CRC CCIP.

### **WEEK 3:**

Basic Networking commands.

### **WEEK 4:**

Establishing a network between computers.

### **WEEK 5:**

Configuring FTP Server for file sharing.

### **WEEK 6:**

Implement Dijkstra's algorithm to compute the Shortest path through a graph.

## **TEXTBOOKS:**

1. Operating System Principles, Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7<sup>th</sup> Edition, John Wiley
2. Data Communications and Networking, Behrouz A. Forouzan, 4<sup>th</sup> Edition, TMH, 2006

## **REFERENCES:**

1. Modern Operating Systems, Andrew S. Tanenbaum, 2<sup>nd</sup> Edition, Pearson/PHI
2. Operating Systems – A Concept Based Approach, D. M. Dhamdhare, 2<sup>nd</sup> Edition
3. Data and Computer Communication, William Stallings, 8<sup>th</sup> Edition, Pearson Prentice Hall India
4. Internetworking with TCP/IP, Volume 1, Douglas Comer, 6<sup>th</sup> Edition, Prentice Hall of India

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### (A19PW4CS03) DESIGN THINKING

#### COURSE OBJECTIVES:

- To inculcate core design principles and applied creativity to develop innovative strategies that better connect engineers with their end users
- To build mindset leading to flow of creative ideas, validating those ideas and prioritizing the best ones
- To incorporate tools that designers need to take a design project from inspiration and insights to ideation and implementation
- To instill full scope of organizational innovation and strategy through knowledge, insight and analytical skills

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Use design thinking and hypothesis-driven innovation processes to develop viable solutions to user challenges

**CO-2:** Use multiple brainstorming techniques to find innovative solutions

**CO-3:** Develop and test a business model or business case to support the viability of the solution

**CO-4:** Prototype a solution to a user challenge

**CO-5:** Investigate the cultural, emotional, technological and business factors relevant to developing new product or service design concept

#### MODULE 1: Revisiting Design Thinking

Creative thinking as basis of innovation; Empathy process for deep understanding of challenge with practical ingenuity; Making sense of observations and insights; Defining a point of view and context

Design thinking skills for Problem Discovery, Definition, and Ideation – Identifying problems in daily lives and in the world at large, Understanding user and customer perspectives, Thinking from the problem before thinking of a solution

#### MODULE 2: Ideation Process

Clear Articulation of problem statement with focus on latent needs; Brainstorming potential solutions; Ideation methods with case-study based approach to using Systematic Inventive Thinking (SIT) Methods such as Addition, Subtraction, Multiplication, Division and Task Unification

Strategic Innovation for competition in future: Linear Innovation vs. non-linear innovation, Understanding and identifying weak signals, 3-box thinking, 3-Box framework and Box-3 ideation

#### MODULE 3: Designing Customer Experience

Understanding Innovation through Design Thinking; Enhancing Customer Experience; Service Design and Development Process and Case Studies; Service Experience Cycle and Case Studies

#### **MODULE 4: Sustainable Design Approaches**

Concern for Environment and Sustainability in Design, Case Studies to understand good Design For Environment (DFE) Decisions; Design Considerations in the five stages of the Product Life Cycle

#### **MODULE 5: Integrative Engineering Design Solutions**

Identifying and resolving issues with working in diverse teams, Modularising, prototype building by different engineering disciplines within the team, validated learning with accessible metrics

#### **MODULE 6: Capstone Project (Interdisciplinary)**

Applying Design Thinking Principles and Methods for Ideation and Prototyping, Testing Solution, Refining Solution, and Taking the Solution to the Users

#### **TEXT BOOKS:**

1. 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization, Vijay Kumar, John Wiley & Sons, ISBN: 978-1118083468, 2012
2. Living with Complexity, Donald A Norman, MIT Press, ISBN: 978-0262528948, 2016
3. Design Thinking for Entrepreneurs and Small Businesses: Putting the Power of Design to Work, Beverly Rudkin Ingle, A Press, ISBN: 978-1430261810, 2013

#### **REFERENCES:**

1. Emotionally Durable Design: Objects, Experiences and Empathy, Jonathan Chapman, 2<sup>nd</sup> Edition, Routledge, ISBN: 978-0415732161, 2015
2. Innovation Design: How Any Organization Can Leverage Design Thinking to Produce Change, Drive New Ideas, and Deliver Meaningful Solutions, Thomas Lockwood, Edgar Papke, New Page Books, ISBN: 978-1632651167, 2017
3. Design Thinking Business Analysis: Business Concept Mapping Applied, Thomas Frisendal, Springer, ISBN: 978-3642434822, 2012
4. Chapter 1: A Simple Framework for Leading Innovation, The Three Box Solution, HBR Press, 2016
5. Design a Better Business: New Tools, Skills and Mindset for Strategy and Innovation, Patrick Van Der Pijl, Justin Lokitz, Lisa Kay Solomon, Erik van der Pluijm, Maarten van Lieshout, Wiley, ISBN: 978-8126565085, 2016

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(A19PC1CS48) BIG DATA COMPUTING

**COURSE OBJECTIVES:**

- To explore the fundamental concepts of data analytics
- To learn to analyze the data analysis techniques
- To explore the techniques related to mining streams
- To understand, explore Hadoop framework technology and its associated tools along with visualization methods

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Identify the major sources of data; apply pre-processing tasks and summary statistics on data

**CO-2:** Understand the concept of Hadoop and analyze data on HDFS and its comparison with other systems

**CO-3:** Work with Hadoop framework and its various components such as PIG, HIVE, HBASE, ZOOKEEPER etc.

**CO-4:** Build various models and visualize data using visualization tools for gaining more insights

**UNIT – I:**

**Data Management:** Introduction, Sources of data, Types of Data, Data preprocessing, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources.

**UNIT – II:**

**Data Analysis:** Introduction, Terminology and concepts, Summary statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT.

**UNIT – III:**

**Hadoop:** Meet Hadoop, Comparison with other systems, A brief history of Hadoop and the Hadoop ecosystem, Analyzing the Data with Hadoop, Hadoop Distributed File System, HDFS concepts, Design of HDFS, Data Flow in HDFS, Developing a Map Reduce Application-How Map Reduce Works.

**UNIT – IV:**

**Frameworks:** Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services –HiveQL – Querying Data in Hive - fundamentals of HBase and ZooKeeper.

**UNIT – V:**

**Introduction to Tableau:** Connecting Tableau to different sources, Understanding the data, Navigating Tableau, drawing basic graphs, understanding showme card, understanding different shelves, understanding marks card, Understanding Aggregation, Granularity, and level of detail, Creating Calculated Fields.

**UNIT – VI:**

**Data Visualization:** Prepare the data for Visualization, Use tools like Tableau, Qlick View and D3, Draw insights out of Visualization tool.

**TEXTBOOKS:**

1. Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Steinbach, Pearson
2. Mining of Massive Datasets, Anand Rajaraman and Jeffrey David Ullman, Cambridge University Press, 2012
3. Hadoop: The Definitive Guide, Tom White, 3<sup>rd</sup> Edition, O'Reilly Media, 2012

**REFERENCES:**

1. Making Sense of Data, Glenn J. Myatt, John Wiley & Sons, 2007
2. Big Data Glossary, Pete Warden, O'Reilly, 2011
3. Data Mining Concepts and Techniques, Jiawei Han, Micheline Kamber, 2<sup>nd</sup> Edition, Elsevier, 2008

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(A19PC1CS09) ARTIFICIAL INTELLIGENCE

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To understand and analyze the importance and basic concepts of artificial intelligence and the use of agents
- To identify, explore the complex problem-solving approaches and strategies
- To describe and apply knowledge representation
- To understand learning approaches with applications and expert systems

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** To apply basic concepts of artificial intelligence (AI) and use of agents into real world scenario

**CO-2:** To formulate and solve the complex problems by using various search techniques

**CO-3:** To represent knowledge and apply rules for solving the real world problems

**CO-4:** To represent the construction of learning and expert system

**UNIT – I:**

**Introduction:** AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

**UNIT – II:**

**Searching:** Searching for solutions, uniformed search strategies – Breadth first search, depth limited Search.

Search with partial information (Heuristic search) Greedy best first search, A\* search, Memory -bounded heuristic search

**Local Search Algorithms:** Hill climbing, Simulated annealing search, Local beam search, Genetic algorithms

**UNIT – III:**

**Constraint Satisfaction Problems:** Backtracking search for CSP's, Local search for CSP

**Game Playing:** Adversial search, Games, Minimax algorithm, optimal decisions in multiplayer games, Alpha-Beta pruning, Evaluation functions, cutting of search.

**UNIT – IV:**

**Knowledge Representation:** Procedural Versus Declarative knowledge, Using Predicate logic, representing facts in logic, functions and predicates, Conversion to clause form, Resolution in propositional logic, Resolution in predicate logic, Unification.

**UNIT – V:**

**Learning:** What is learning, Learning by Taking Advice, Learning in Problem-solving, Learning from example: induction, Explanation-based learning.

Introduction to Neural Networks, Different types of Learning in Neural Networks, Applications of Neural Networks, Recurrent Networks.

**UNIT – VI:**

**Expert System:** Representing and using Domain Knowledge, Reasoning with knowledge, Expert System Shells-examples, Knowledge acquisition skills-examples.

**TEXT BOOKS:**

1. Artificial Intelligence A Modern Approach, Stuart Russell and Peter Norvig, 3<sup>rd</sup> Edition, Pearson Education
2. Artificial Intelligence, Kevin Knight, Elaine Rich, B. Shivashankar Nair, 2<sup>nd</sup> Edition, 2008
3. Artificial Neural Networks, B. Yagna Narayana, PHI

**REFERENCES:**

1. Expert Systems: Principles and Programming, Giarrantana, Riley, 4<sup>th</sup> Edition, Thomson
2. PROLOG Programming for Artificial Intelligence, Ivan Bratka, 3<sup>rd</sup> Edition, Pearson Education
3. Neural Networks, Simon Haykin, PHI
4. Artificial Intelligence, Patrick Henny Winston, 3<sup>rd</sup> Edition, Pearson Education

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(A19PC1CS08) COMPILER DESIGN

**COURSE OBJECTIVES:**

- To outline the usage of different phases of compiler
- To understand the various techniques of parsing in a compilation process
- To utilize the compiler optimization methods to improve the intermediate
- To explain the code generator for the optimized code

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Develop the lexical analyzer

**CO-2:** Construct the parse tree for checking the grammatical errors in a certain programming language

**CO-3:** Apply the code optimization techniques on intermediate code for its improvement

**CO-4:** Construct the target code on improved intermediate code

**UNIT – I:**

**Overview of Compilation:** Phases of Compilation – Lexical Analysis, Regular Grammar and regular expression for common programming language features, pass and Phases of translation, interpretation, LEX tool introduction.

**UNIT – II:**

**Top-Down Parsing:** Context free grammars, Top down parsing –Backtracking, recursive descent parsing, Predictive parsing, LL(1) parsing, Pre-processing steps required for predictive parsing.

**UNIT – III:**

**Bottom-Up Parsing:** Shift-Reduce parsing, SLR, CLR and LALR parsing, handling ambiguous grammar. YACC – Automatic parser generator tool.

**UNIT – IV:**

**Syntax Directed Translation:** Syntax directed definitions, Construction of syntax trees.

**Runtime Environment:** Storage Organization, Activation records, Storage allocation strategies.

**Intermediate Code Generation:** Intermediate forms of source Programs – abstract syntax tree, three address codes, Implementation of 3-address statements. Conversion of popular Programming languages language Constructs into Intermediate code forms–assignment statements, Boolean expressions.

**UNIT – V:**

**Code Optimization:** Types of code optimization, Criteria for code improving transformation, the Principle sources of optimization – function preserving transformations, loop optimizations, DAG based Optimization of basic blocks.

**UNIT – VI:**

**Code Generation:** issues of code generation of a code generator, a simple code generator, register allocation and assignment, peephole optimization, Generating



code from DAGS- Rearranging the order, A Heuristic ordering for DAGs, Labelling algorithm for code generation.

**TEXT BOOKS:**

1. Compilers: Principles, Techniques, and Tools, A. V. Aho, Ravi Sethi, J. D. Ullman, Pearson Education
2. Modern Compiler Implementation in C, Andrew N. Appel, Cambridge University Press

**REFERENCES:**

1. Lex & Yacc, John R. Levine, Tony Mason, Doug Brown, O'Reilly
2. Modern Compiler Design, Dick Grune, Henry E. Bal, Criel T. H. Jacobs, Wiley Dreamtech

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### (A19PC1IT05) WEB TECHNOLOGIES

#### COURSE OBJECTIVES:

- To introduce the basic concepts and techniques in building static web pages
- To understand the usage of XML and transportation of data
- To implement Tomcat Server and make static pages into dynamic
- To implement web sites and deploy into Server
- To explore data base access methods and connect front end to backend database

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand the basics of Web Designing using HTML, DHTML, and CSS

**CO-2:** Understand what XML is and how to parse and use XML Data with Java

**CO-3:** Learn about client-side scripting, form validation, and AJAX programming

**CO-4:** Understand server-side scripting with JSP and servlets

#### UNIT – I:

**Introduction to Web Programming:** List, Tables, images, forms, Frames

**Cascading Style Sheets:** Introduction, CSS overview, Types of CSS, CSS Rules, Class and ID selectors, CSS properties, Writing Internal and External CSS.

#### UNIT – II:

**Client-side Scripting:** Introduction to Javascript, Javascript language – declaring variables, scope of variables, functions, Event handlers (Keyboard Events, Mouse events, Form Events, Window events), Document Object Model, Form validation.

#### UNIT – III:

**XML:** Introduction to XML, Defining XML tags, Attributes and Values, Document type definition, XML Schemas, Document Object model, XHTML Parsing XML Data - DOM and SAX parsers in Java

#### UNIT – IV:

**Web Servers:** Introduction, Apache HTTP Server, Apache Tomcat, Installation of Tomcat.

**Introduction to Servlets:** Lifecycle of a Servlet, The Servlet API, Reading Servlet parameters, Reading initialization parameters, Handling HTTP Request & Responses, writing and deploying Servlets, Using Cookies and sessions, connecting to a database using JDBC

#### UNIT – V:

**Introduction to JSP:** The Anatomy of a JSP Page, JSP Processing, Declarations, Directives, Expressions, Code Snippets, implicit objects, Using Beans in JSP Pages, Using Cookies and session for session tracking, connecting to database in JSP.

#### UNIT – VI:

**AJAX:** Introduction, AJAX Components, Handling Dynamic HTML with Ajax, XML Http Request. Ajax Using XML and XML Http Request, Accessing, Creating and Modifying

XML Nodes, Loading XML Data into an HTML Page, Receiving XML Responses, Handling Response XML.

**TEXT BOOKS:**

1. Web Programming, Building Internet Applications, Chris Bates, 2<sup>nd</sup> Edition, Wiley Dreamtech
2. Core Servlets and Java Server Pages Volume 1: Core Technologies, Marty Hall and Larry Brown Pearson
3. Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, ASP.NET, XML and Ajax, Black Book, Kogent Learning

**REFERENCES:**

1. Programming World Wide Web, Sebesta, Pearson
2. Internet and World Wide Web – How to Program, Dietel and Nieto, PHI/Pearson Education Asia
3. Jakarta Struts Cookbook, Bill Siggelkow, SPD O'Reilly
4. Java: The Complete Reference, Herbert Schildt, 7<sup>th</sup> Edition, TMH

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(A19PE1CS48) DATA SCIENCE FOR ENGINEERS

**COURSE OBJECTIVES:**

- To acquire classification skills in data science
- To analyze Principle Component Analysis
- To develop the skills of interpreting K-Nearest neighbor
- To develop the ability to construct decision tree

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Identify the need for data science classification techniques with real time data

**CO-2:** Design an application with classification algorithms

**CO-3:** Employ efficient methods to construct decision tree

**CO-4:** Apply performance measurement of models for algorithms

**UNIT – I:**

**Principal Component Analysis (PCA):** Why learn PCA, Geometric intuition of PCA, alternative formulation of PCA distance minimization, Eigen values and Eigen vectors, visualizing MNIST dataset, Limitations of PCA, PCA code example, PCA for dimensionality reduction, what is t-SNE, neighborhood of a point embedding, Geometric intuition of t-SNE.

**UNIT – II:**

**K-Nearest Neighbor (KNN):** How classification works, data matrix notation, classification vs regression, k-nearest neighbor's geometric intuition, failure cases of KNN, distance measures, Euclidean distance, Manhattan distance, cosine distance, cosine similarity, measuring effectiveness of KNN, decision surface for KNN, overfitting and underfitting.

**UNIT – III:**

**Cross Validation:** Need for cross validation, K-fold cross validation, determining, determining overfitting and underfitting, KNN for regression, weighted KNN, Voronoi diagram, KD tree, code sample of decision boundary, code sample of cross validation.

**UNIT – IV:**

**Bias and Variance:** Classification diagrams in various situations, Imbalanced vs balanced data set, under sampling, multi class classification, KNN given a distance measure, train & test differences, impact of outliers a model, one hot encoding, categorical and ordinal features, handling missing values by imputation, bias and variance trade off, intuitive understanding of bias and variance.

**UNIT – V:**

**Performance Measurement of Models:** Accuracy, confusion matrix, precision, recall, receiver operating characteristics curve(ROC), log-less, mean absolute deviation errors, R-Squared co-efficient of determination, distribution of errors.

**UNIT – VI:**

**Overfitting and Underfitting:** Geometric intuition of decision tree, Sample Decision tree, Building a decision tree(Entropy), KL Divergence, Building a decision tree (information gain), Building a decision tree(Gini Impurity), overfitting and underfitting, Code Sample.

**TEXTBOOKS:**

1. Principal Component Analysis, I. T. Jolliffe, 2<sup>nd</sup> Edition, Springer
2. Machine Learning, Tom M. Mitchell, McGraw-Hill
3. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, 2<sup>nd</sup> Edition, Springer

**REFERENCES:**

1. Core Python Programming, Wesley J. Chun, Prentice Hall, 2006
2. Learning Python, Mark Lutz, 4<sup>th</sup> Edition, O'Reilly, 2009
3. Data Mining Concepts and Techniques, Jiawei Han, Micheline Kamber, Jian Pei, 3<sup>rd</sup> Edition

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(A19PE1CS06) SCRIPTING LANGUAGES

**COURSE OBJECTIVES:**

- To appreciate the nature of scripting and the role of scripting languages
- To effectively apply knowledge of scripting to new situations and learn from the experience
- To analyze requirements of software systems for the purpose of determining the suitability of implementation of PERL and Ruby
- To design and implement software solutions that accommodate specified requirements and constraints, based on analysis or modeling or requirements specification

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Classify Scripting Languages and application programming languages

**CO-2:** Apply the syntax and semantics of languages for effective scripting

**CO-3:** Develop a Web applications for decision making

**CO-4:** Design and implement Scripting Languages for software solutions

**UNIT – I:**

**Introduction to Scripting Language:** Scripts and Programs, Origin of Scripting, Scripting Today, Characteristics of Scripting Languages, Uses for Scripting Languages, Web Scripting, and the universe of Scripting Languages.

**UNIT – II:**

**Fundamentals of Perl:** PERL- Names and Values, Variables, Scalar Expressions, Control Structures, arrays, list, hashes, strings, pattern and regular expressions, subroutines.

**UNIT – III:**

**Advanced Perl:** Finer points of looping, pack and unpack, filesystem, eval, data structures, packages, modules, objects, interfacing to the operating system, Creating Internet ware applications, Dirty Hands Internet Programming, security Issues.

**UNIT – IV:**

**Facets of Ruby:** Ruby new, Classes, Objects and Variables, Containers, Blocks and Iterators, Standard Types, Methods, Expressions, Exceptions, Catch, And Through, Modules, Basic Input and Output.

**UNIT – V:**

**Ruby in its Setting:** The structure and Execution of Ruby Programs, Package Management with RUBYGEMS, Ruby and web: Writing CGI scripts, cookies, Choice of Webservers, SOAP and webservice

**UNIT – VI:**

RubyTk – Simple Tk Application, widgets, Binding events, Canvas, scrolling.

**Extending Ruby:** Ruby Objects in C, the Jukebox extension, Memory allocation, Ruby Type System, Embedding Ruby to Other Languages, Embedding a Ruby Interpreter

**TEXT BOOKS:**

1. The World of Scripting Languages, David Barren, Wiley Publications
2. Programming Ruby, The Pragmatic Programmers Guide, Dave Thomas, 2<sup>nd</sup> Edition

**REFERENCES:**

1. Perl by Example, E. Quigley, Pearson Education
2. Programming Perl, Larry Wall, T. Christiansen and J. Orwant, O'Reilly, SPD
3. Ruby Programming Language, David Flanagan and Yukihiro Matsumoto, O'Reilly

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(A19PE1CS08) INFORMATION SECURITY MANAGEMENT

**COURSE OBJECTIVES:**

- To introduce the terminology, technology and fundamentals of information security management
- To prevent data leakage and introduce DLP
- To introduce information security policies procedures and guidelines
- To introduce information security management roles, responsibilities and information security performance metrics

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Explain the fundamentals of information security management.

**CO-2:** Identify the areas of data leakage and implements the DLP system

**CO-3:** Design and explain information security policies procedures and guidelines

**CO-4:** Illustrate information security management roles, responsibilities and develop information security performance metrics

**UNIT – I:**

**Information Security Management:** Information Security Overview, Threats and Attack Vectors, Types of Attacks, Common Vulnerabilities and Exposures (CVE), Security Attacks, Fundamentals of Information Security.

**UNIT – II:**

**Fundamentals of Information Security:** Key Elements of Networks, Logical Elements of Network, Elements of information Security, Principles and concepts, Types of controls.

**UNIT – III:**

**Data Leakage:** What is Data Leakage and statistics, Data Leakage Threats, Reducing the Risk of Data Loss, Key Performance Indicators (KPI), Organizational data classification, Content Awareness, Content Analysis techniques, Data Protection, DLP Limitations.

**UNIT – IV:**

**Information Security Policies, Procedures and Guidelines:** Information Security Policies-necessity-key elements & characteristics, Configuration, Security Standards-Guidelines & Frameworks etc. Laws, Regulation and Guide lines.

**UNIT – V:**

**Information Security Management-Roles and Responsibilities:** Security Roles & Responsibilities, Accountability, Roles and Responsibilities of Information Security Management, information Data security team structure, security incident response team.

**UNIT – VI:**

**Information security Performance Metrics:** Introduction -security Metrics, Types of security Metrics, Using Security Metrics, Developing the metric process, Metrics and reporting,



**TEXT BOOKS:**

1. Management of Information Security, Michael E. Whitman and Herbert J. Mattord, 4<sup>th</sup> Edition, Cengage Learning
2. Security Analyst Facilitator - version 3, NASSCOM

**REFERENCES:**

1. Security Analyst Student Book – version 3, NASSCOM

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### (A19PE1CS20) CLOUD TECHNOLOGIES

#### COURSE OBJECTIVES:

- To explain the evolving computer model called cloud computing
- To introduce the various levels of services that can be achieved by cloud
- To analyze the concepts of IaaS, PaaS, SaaS, Public and Private Clouds
- To host applications for which the services can be delivered to consumers rapidly at minimal cost

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO1:** Explain cloud computing, virtualization and classify services of cloud computing

**CO2:** Illustrate architecture and programming in cloud

**CO3:** Build virtual machines in a datacenter/hypervisor environment

**CO4:** Describe the platforms for development of cloud applications and list the application of cloud

#### UNIT – I:

**Introduction:** Cloud computing at a glance, the vision of cloud computing, Defining a Cloud, A closer Look, Cloud computing reference model, Characteristics and benefits, Challenges ahead, Historical developments: Distributed Systems, Virtualization, Web 2.0, Service-Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments: Application Development, Infrastructure and System Development, Computing Platforms and Technologies, Amazon Web Services (AWS), Google AppEngine, Microsoft Azure, Hadoop, Force.com and Salesforce.com, Manjra soft Aneka

#### UNIT – II:

**Cloud Computing Architecture:** Introduction, The Cloud Reference Model, Types of Clouds, Economics of the Cloud, Open Challenges, Aneka: Framework overview Anatomy of the Aneka container, Building Aneka clouds, Cloud programming and management

#### UNIT – III:

**Virtualization:** Introduction to Virtualization: Objectives of virtualization, history of virtualization, benefits of virtualized technology, the virtual service desk, what can be virtualized, related forms of computing, cloud computing, software as a service – SaaS, grid computing, utility computing, virtualization processes.

#### UNIT – IV:

**Virtualization Technologies:** Ubuntu (server edition), Altiris, windows, server, software virtualization, VMware, intel virtualization, red hat virtualization, SoftGrid application, Linux virtualization, desktop virtualization, hardware virtualization, resource virtualization, processor virtualization, application virtualization.

**UNIT – V:**

**Concurrent Computing:** Introducing parallelism for single-machine computation, Programming applications with threads, Multithreading with Aneka, Programming applications with Aneka threads, High-Throughput Computing: Task computing, Task-based application models, Aneka task-based programming, Data-Intensive Computing: What is data-intensive computing? Technologies for data-intensive computing.

**UNIT – VI:**

**Cloud Platforms in Industry:** Amazon web services, Google App Engine, Microsoft Azure

**Cloud Applications:** Scientific applications, Business and consumer applications, Energy efficiency in clouds, Market-based management of clouds, Federated clouds/Intercloud, Third - party cloud services

**TEXT BOOKS:**

1. Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, McGraw-Hill
2. Cloud Computing Virtualization Specialist Complete Certification Kit - Study Guide Book, Ivanka Menken, Gerard Blokdiijk, 2009

**REFERENCES:**

1. Cloud Computing: A Practical Approach, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, Tata McGraw-Hill, 2011
2. Enterprise Cloud Computing, Gautam Shroff, Cambridge University Press, 2010

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(A19PE1CS14) INFORMATION RETRIEVAL SYSTEMS

**COURSE OBJECTIVES:**

- To describe the differences between repositories like Base Management Systems, Information retrieval systems and data warehouse
- To discover various pre-processing techniques which can apply on text documents to outline the structure of queries and documents
- To articulate fundamental functions used in information retrieval such as automatic indexing, abstracting, and clustering
- To learn the important concepts, algorithms, and data/file structures that are necessary to specify, design, and implement Information Retrieval (IR) systems

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Identify and understand the relationships between various Repository Systems

**CO-2:** Apply knowledge of data structures and indexing methods in information retrieval Systems

**CO-3:** Implement various clustering, searching techniques and algorithms on Information systems

**CO-4:** Analyze clustering techniques and algorithms using evaluation measures

**UNIT – I:**

**Introduction:** Definition, Objectives, Functional Overview, Relationship to DBMS, Digital libraries and Data Warehouses, Information Retrieval System Capabilities – Search, Browse, Miscellaneous.

**UNIT – II:**

**Cataloging and Indexing:** Objectives, Indexing Process, Automatic Indexing, Information Extraction

**Data Structures:** Introduction, Stemming Algorithms, Inverted file structures, N – gram data structure, PAT data structure, Signature file structure, Hypertext data structure.

**UNIT – III:**

**Automatic Indexing:** Classes of automatic indexing, Statistical Indexing, Natural language, Concept indexing, Hypertext linkages.

**Document and Term Clustering:** Introduction, Thesaurus generation, Item clustering, Hierarchy of clusters.

**UNIT – IV:**

**User Search Techniques:** Search statements and binding, Similarity measures and ranking, Relevance feedback, Selective dissemination of information search, weighted searches of Boolean Systems, Searching the Internet and hypertext.

**UNIT – V:**

**Text Search Algorithms:** Introduction, Software text search algorithms, Hardware text search systems.

**UNIT – VI:**

**Information System Evaluation:** Introduction, Measures used in system evaluation, Measurement example – TREC results.

**TEXT BOOKS:**

1. Information Storage and Retrieval Systems: Theory and Implementation, Kowalski, Gerald, Mark T. Maybury, Springer
2. Modern Information Retrieval, Ricardo Baeza – Yates, Pearson Education, 2007

**REFERENCES:**

1. Information Retrieval: Algorithms and Heuristics, David A. Grossman and Ophir Frieder, 2<sup>nd</sup> Edition, Springer
2. Information Retrieval Data Structures and Algorithms, Frakes W. B., Ricardo Baeza-Yates, Prentice Hall, 1992

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### (A19PC2CS49) BIG DATA COMPUTING LABORATORY

#### COURSE OBJECTIVES:

- To explore and understand various HDFS commands in Hadoop environment
- To understand the concept of Hadoop framework and its components
- To explore various Big Data tools for data processing
- To analyse data using visualization tools

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Explore various HDFS commands on Hadoop file system

**CO-2:** Illustrate map reduce programming framework on large data sets in a distributed environment

**CO-3:** Demonstrate different Big Data tools such as HIVE, PIG, and SQOOP

**CO-4:** Extract large data sets to perform visualization and data analysis tasks

#### LIST OF EXPERIMENTS:

### 1. HDFS (Storage)

#### A. Hadoop Storage File system

Your first objective is to create a directory structure in HDFS using HDFS commands. Create the local files using Linux commands and move the files to HDFS directory and vice versa.

I. Write a command to create the directory structure in HDFS.

II. Write a Command to move file from local unix/linux machine to HDFS.

#### B. Viewing Data Contents, Files and Directory

Try to perform these simple steps:

a) Write HDFS command to see the contents of files in HDFS.

b) Write HDFS command to see contents of files which are present in HDFS.

#### C. Getting Files data from the HDFS to Local Disk

I. Write a HDFS command to copy the file from HDFS to local file system.

To process any data first move the data in HDFS. All files stored in HDFS can be accessed using HDFS commands.

Lab Instructions:

i. Your objective is to use HDFS commands to move data to HDFS for processing data.

2. Map Reduce Programming (Processing data).

Hadoop Map-Reduce framework is developed using Java, but the framework allows you to write programs in other languages as well.

### **A. Word Count**

The word count problem is the most famous using map reduce program. Same thing we can do with java but takes lot of time with huge file, in MR it will process less time even with huge and distributed files. The objective is to count the frequency of words of a large text.

Lab Instructions:

i. Develop MapReduce example program in a MapReduce environment to find out the number of occurrences of each word in a text file

### **B. Most Frequent Words Count**

Use the output from the previous program to list the most frequent words with their counts.

**Lab Instructions:**

i. Use the same strategy of breaking the programs in three parts. Copy the files from the previous exercise and use them as a starting point.

ii. Load the data from the output by using third filter to load the files.

### **3. Data Processing Tool – Hive (NOSQL query based language)**

Hive command line tool allows you to submit jobs via bash scripts.

**Identifying properties of a data set:**

We have a table 'user data' that contains the following fields:

data\_date: string

user\_id: string

properties: string

The properties field is formatted as a series of attribute=value pairs.

Ex: Age=21; state=CA; gender=M;

**Lab Instructions:**

i. Create the table in HIVE using hive nosql based query.

ii. Fill the table with sample data by using some sample data bases.

iii. Write a program that produces a list of properties with minimum value(min\_value), largest value(max\_value) and number of unique values. Before you start, execute the prepare step to load the data into HDFS.

iv. Generate a count per state.

Now that extracted the properties, calculate the number of records per state.

**Lab Instructions:**

i. Write a program that lists the states and their count from the data input.

### **4. Data Processing Tool – Pig (Latin based scripting lang)**

Pig command line tool like the Hive allows you to submit jobs via bash scripts.

#### **A. Simple Logs**

We have a set of log files and need to create a job that runs every hour and perform some calculations.

The log files are delimited by a 'tab' character and have the following fields:

a) site

b) hour\_of\_day

c) page\_views

d) data\_date

The log files are located on the prepare folder. Load them in HDFS at data/ pig/ simple\_logs folder and use them as the input.

Important: In order to load tab delimited files use pigStorage ('\u0001').

### **Lab Instructions:**

Create a program to:

- i. Calculate the total views per hour per day.
- ii. Calculate the total views per day.
- iii. Calculate the total counts of each hour across all days.
- iv. We can write word count script by passing text file as input

### **5. SQOOP**

It is used to import and export data from SQL to HDFS and Vice versa.

Before processing any data first need to import data into HDFS. As of now seen importing files into HDFS but using sqoop tool we can import SQL table data into hive table.

- I. Create table in HIVE using hive query language.
- II. Import the sql table data into hive using sqoop too.
- III. Export hive table data into local machine and into SQL.

### **6. Exploring ARIMA model.**

#### **TEXTBOOKS:**

1. Data Analytics using R, Seema Acharya, McGraw-Hill, 2019
2. R for Data Science, Import, Tidy, Transform, Visualize, and Model Data, Hadley Wickham, Garrett Golemund, 2016
3. Hadoop: The Definitive Guide, Tom White, 3<sup>rd</sup> Edition, O'Reilly Media, 2012

#### **REFERENCES:**

1. Data Analytics with R, Bharti Motwani, 2019
2. Data Science-Theory, Analysis and Applications, Qurban A. Memon, Shakeel Ahmed Khoja, 2019
3. Big Data Glossary, Pete Warden, O'Reilly, 2011



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**(A19PC2IT05) WEB TECHNOLOGIES LABORATORY**

**COURSE OBJECTIVES:**

- To learn various fundamental concepts for developing websites and web-based applications
- To know about the technology for data transportation among incompatible systems and applications
- To develop static and dynamic websites
- To implement various client side and server-side scripting technologies for developing web applications

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand the concepts, analyze and design static and dynamic web pages with HTML, DHTML, java script and Cascading Styles sheets

**CO-2:** Create, validate and display XML documents

**CO-3:** Analyze and build dynamic and interactive web applications using servlets, jsp and JDBC

**CO-4:** Design and develop web applications with JSP concepts

**LIST OF EXPERIMENTS:**

**WEEK 1:**

Design the following static web pages required for an online bookstore web site.

**1) HOME PAGE:**

The static home page must contain three frames.

Top frame : Logo and the college name and links to Home page, Login page, Registration page, Catalogue page and Cart page (the description of these pages will be given below).

Left frame : At least four links for navigation, which will display the catalogue of respective links. For e.g.: When you click the link "CSE" the catalogue for CSE Books should be displayed in the Right frame.

Right frame: The pages to the links in the left frame must be loaded here. Initially this page contains description of the web site.

|                            |                             |              |           |      |
|----------------------------|-----------------------------|--------------|-----------|------|
| Logo                       | Web Site Name               |              |           |      |
| Home                       | Login                       | Registration | Catalogue | Cart |
| CSE<br>ECE<br>EEE<br>CIVIL | Description of the Web Site |              |           |      |

Fig 1.1

**2) LOGIN PAGE:**

This page looks like below:

|               |
|---------------|
| Web Site Name |
|---------------|

|      |       |              |           |   |
|------|-------|--------------|-----------|---|
| Logo |       |              |           |   |
| Home | Login | Registration | Catalogue | Cart                                      |
| CSE  | ECE   | EEE          | CIVIL     | Login :<br>Password:<br>Submit      Reset |



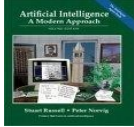



### 3) CATALOGUE PAGE:



The catalogue page should contain the details of all the books available in the web site in a tabular format.

The details should contain the following:

1. Snap shot of Cover Page.
2. Book Title, Author Name, Publisher.
3. Price.
4. Add to cart button.

5.

| Logo  | Web Site Name   |                                      |           |   |
|-------|---|--------------------------------------|-----------|---|
| Home  | Login   | Registration                         | Catalogue | Cart  |
| CSE   |  | Book : XML Bible<br>Author : Winston | \$ 40.5   |  |
| ECE   |   | Publication : Wiely                  |           |   |
| EEE   |  | Book : AI<br>Author : S.Russel       | \$ 63     |  |
| CIVIL |   | Publication :<br>Princeton hall      |           |   |
|       |  | Book : Java 2<br>Author : Watson     | \$ 35.5   |  |
|       |   | Publication : BPB publications       |           |   |

|  |   |  |       |   |
|--|---|--|-------|---|
|  |  | Book : HTML in 24 hours<br>Author : Sam Peter<br>Publication : Sam publication | \$ 50 |  |
|--|---|--|-------|---|

**WEEK 2:**

**4) CART PAGE:**

The cart page contains the details about the books which are added to the cart. The cart page should look like this:

|       |               |              |                |      |
|-------|---------------|--------------|----------------|------|
| Logo  | Web Site Name |              |                |      |
| Home  | Login         | Registration | Catalogue      | Cart |
| IT    | Book name     | Price        | Quantity       |      |
| CSE   | Amount        |              |                |      |
| ECE   |               |              |                |      |
| EEE   | Java 2        | \$35.5       | 2              |      |
| CIVIL | \$70          |              |                |      |
|       | XML bible     | \$40.5       | 1              |      |
|       | \$40.5        |              |                |      |
|       |               |              | Total amount - |      |
|       | \$130.5       |              |                |      |

**5) REGISTRATION PAGE:**

Create a "registration form "with the following fields

- 1) Name (Text field)
- 2) Password (password field)
- 3) E-mail id (text field)
- 4) Phone number (text field)
- 5) Sex (radio button)
- 6) Date of birth (3 select boxes)
- 7) Languages known (check boxes – English, Telugu, Hindi, Tamil)
- 8) Address (text area)

**WEEK 3:**

**VALIDATION:**

a) Write JavaScript to validate the following fields of the above registration page.

1. Name (Name should contains only alphabets and the length should not be less than 6 characters).

2. Password (Password should not be less than 6 characters length).
  3. E-mail id (should not contain any invalid and must follow the standard pattern name@domain.com)
  4. Phone number (Phone number should contain 10 digits only).
- b) Write JavaScript to validate the above login page with the above parameters.

#### WEEK 4:

Design a web page using CSS (Cascading Style Sheets) which includes the following:

- 1) Use different font, styles:

In the style definition you define how each selector should work (font, color etc.). Then, in the body of your pages, you refer to these selectors to activate the styles. For example:

```
<HTML>
<HEAD>
<style type="text/css">
  BODY {background-image:url(myimage.gif);}
  B.headline {color:red; font-size:22px; font-family:arial; text-decoration:underline}
</style>
</HEAD>
<BODY>
<b>This is normal bold</b><br>
<b class="headline">This is headline style bold</b>
</BODY>
</HTML>
```

- 2) Set a background image for both the page and single elements on the page. You can define the background image for the page like this:

- 3) Control the repetition of the image with the background-repeat property. As background-repeat: repeat Tiles the image until the entire page is filled, just like an ordinary background image in plain HTML.

- 4) Define styles for links as
  - A:link
  - A:visited
  - A:active
  - A:hover

Example:

```
<style type="text/css">
A:link {text-decoration: none}
A:visited {text-decoration: none}
A:active {text-decoration: none}
```

```
A:hover {text-decoration: underline; color: red;}
</style>
```

5) Work with layers:

For example:

LAYER 1 ON TOP:

```
<div style="position:relative; font-size:50px; z-index:2;">LAYER 1</div>
<div style="position:relative; top:-50; left:5; color:red; font-size:80px; z-
index:1">LAYER 2</div>
```

LAYER 2 ON TOP:

```
<div style="position:relative; font-size:50px; z-index:3;">LAYER 1</div>
<div style="position:relative; top:-50; left:5; color:red; font-size:80px; z-
index:4">LAYER 2</div>
```

6) Add a customized cursor: Selector {cursor:value}

For example:

```
<html>
<head>
<style type="text/css">
.xlink {cursor:crosshair}
.hlink{cursor:help}
</style>
</head>
<body>
<b>
<a href="mypage.htm" class="xlink">CROSS LINK</a>
<br>
<a href="mypage.htm" class="hlink">HELP LINK</a>
</b>
</body>
</html>
```

**WEEK 5:**

**Write an XML file which will display the Book information which includes the following:**

- 1) Title of the book
- 2) Author Name
- 3) ISBN number
- 4) Publisher name
- 5) Edition
- 6) Price

**Write a Document Type Definition (DTD) to validate the above XML file. Display the XML file as follows.**

The contents should be displayed in a table. The header of the table should be in color GREY. And the Author names column should be displayed in one color and should be capitalized and in bold. Use your own colors for remaining columns.

Use XML schemas XSL and CSS for the above purpose.

Note: Give at least for 4 books. It should be valid syntactically. Hint: You can use some xml editors like XML-spy

**WEEK 6:**

Install TOMCAT web server.

While installation assign port number 8000 to TOMCAT. Make sure that these ports are available i.e., no other process is using this port.

Access the above developed static web pages for books web site, using these servers by putting the web pages developed in week-1 and week-2 in the document root.

Access the pages by using the urls: <http://localhost:8000/vnr/books.html>

**WEEK 7:**

**User Authentication:** Assume four users user1, user2, user3 and user4 having the passwords pwd1, pwd2, pwd3 and pwd4 respectively. Write a servlet for doing the following.

- I. Create a Cookie and add these four user id's and passwords to this Cookie.
- II. Read the user id and passwords entered in the Login form (week1) and authenticate with the values (user id and passwords ) available in the cookies.
  - If he is a valid user (i.e., user-name and password match) you should welcome him by name(user-name) else you should display "You are not an authenticated user ".
  - Use init-parameters to do this. Store the user-names and passwords in the web.xml and access them in the servlet by using the getInitParameters() method.

**WEEK 8:**

```
CREATE TABLE Students (student-id, student-name, course, branch, year, studentemailid);
```

```
Faculty(faculty_id,facultyname,studentid,studentname,course,year,facultyemailid)
```

- I. Write a servlet program to retrieve the names of the student who study a particular course.
- II. Write a servlet program to retrieve the names of the student who study a particular course and year.
- III. Write a servlet program to retrieve the names of the student,course,branch,year who study under a particular faculty.(Note the Input is provided from the HTML form).

**WEEK 9:**

Write a servlet program which does the following job: Insert the details of the 3 or 4 users who register with the web site by using registration form. Authenticate the user when he submits

the login form using the user name and password from the database.

**WEEK 10:**

Create a table with attributes (emp\_id, emp\_name, job\_name, joining\_date, salary, department)

- I. Write a JSP program to display the names of the employee, empid, salary and department joined after the given input joining date(The input joining date must be given from the HTML form)
- II. Write a JSP program to display the names of the employee with empid, salary, department and the number of days worked from their joining date to till date.

**WEEK 11:**

Create a table book (book\_id, booktitle, author, price)

- I. Write a JSP program to insert the data to the mysql database from the HTML form.
- II. Write a JSP program to retrieve the data from the table book given the name of the author. If author is not found, your program must display no author is found.
- III. Write a JSP program to retrieve different authors of the same book given the title of the book in the HTML form.

**WEEK 12:**

Develop VNRVJIET web portal to promote college heritage in terms of Technical Fests, Departments, Facilities and Training & Placement.

**TEXT BOOKS:**

1. Web Programming, Building Internet Applications, Chris Bates, 2<sup>nd</sup> Edition, Wiley Dreamtech
2. Core Servlets and Java Server Pages Volume 1: Core Technologies, Marty Hall and Larry Brown, Pearson

**VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY**

**B.Tech. VI Semester**

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**(A19HS2EN05) ADVANCED ENGLISH COMMUNICATION SKILLS LABORATORY**

(Common to all branches)

**COURSE OBJECTIVES:**

- To enable students to understand the principles and process of Technical Writing
- To train students to write technical documents such as Applications, Resumes, SOPs, Proposals and Technical Reports
- To train students to speak accurately and fluently for participation in Presentations, Group Discussions and interviews.
- To train students in soft skills to make them effective individuals

**COURSE OUTCOMES:** After completion of the course the student is able to:

**CO-1:** Summarize and synthesize information and produce technical writing that is required in academics as well as in the engineering profession

**CO-2:** Employ principles of TW and writing process to produce technical documents such as cover letters, resume, SOP, Project Proposals and Technical Reports

**CO-3:** Actively participate in group discussions/interviews and prepare & deliver effective presentations

**CO-4:** Become an effective individual through goal setting & Career Planning & function effectively in multi-disciplinary and heterogeneous teams through the knowledge of teamwork, Inter-personal relationships, conflict management and leadership quality

**UNIT – I:**

**The Concept of Technical Communication:**

1. Understanding the concept of Technical Communication
2. Technical Writing (TW)- Definition, Principles and Processes
3. Summarizing and Synthesizing
4. Editing

**UNIT – II:**

**Application Writing:**

1. Formal Letters (Indian and Western styles); Cover Letter
2. Resumé and SoP Writing
3. E-Correspondence and Netiquette

**UNIT – III:**

**Presentation Skills:**

1. SWOC Analysis
2. Self -Introduction
3. Oral Presentations
4. Powerpoint Presentations



#### **UNIT – IV:**

##### **Report Writing:**

1. Technical Report —Categories, Formats, Styles and Types
2. Proposal Writing
3. Writing Agenda & Minutes

#### **UNIT – V:**

##### **Employability Skills-1:**

1. Self Assessment; Values & Beliefs; Self Esteem
2. Nonverbal Communication
3. Group Discussions

#### **UNIT – VI:**

##### **Employability Skills-2:**

1. Personal goal setting & Career Planning
2. Interview Skills – Face to Face
3. Interview Skills – Telephonic / Video

#### **TEXT BOOKS:**

1. Technical Writing Essentials, Suzan Last, University of Victoria, 2019  
(Technical Writing Essentials by Suzan Last is licensed under a Creative Commons Attribution 4.0 International License)
2. Technical Communication: A Practical Approach, William S. Pfeiffer, 7<sup>th</sup> Edition, Longman, 2012
3. Reports In Paul V. Anderson's Technical Communication: A Reader-Centered Approach, Anderson, Paul V. 5<sup>th</sup> Edition, Boston Heinle 2003

#### **REFERENCES:**

1. Communication in the workplace: What can NC State students expect? J. Swartz, S. Pigg, J. Larsen, J. Helo Gonzalez, R. De Haas, and E. Wagner, Professional Writing Program, North Carolina State University, 2018 [Online] Available:<https://docs.google.com/document/d/1pMpVbDRWIN6HssQQQ4MeQ6U-oB-sGUrRswD7feuRB0/edit> ↵
2. Technical Communication, Burnett, Rebecca, 5<sup>th</sup> Edition, Heinle 2001
3. Technical Writing Process and Product, Gerson Sharon J. and Steven Gerson: 3<sup>rd</sup> Edition, New Jersey: Prentice Hall 1999
4. Technical Communication: Situations and Strategies, Markel, Mike, 8<sup>th</sup> Edition 2006-2007
5. [https://kupdf.net/download/learner-english-pdf\\_1pdf\\_59beb5ec08bbc55c18686ee6\\_pdf](https://kupdf.net/download/learner-english-pdf_1pdf_59beb5ec08bbc55c18686ee6_pdf)

B.Tech. VI Semester

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**(A19MN6HS03) GENDER SENSITIZATION**

**COURSE DESCRIPTION:**

This course offers an introduction to Gender Studies, an interdisciplinary field that asks critical questions about the meanings of sex and gender in society. The primary goal of this course is to familiarize students with key issues, questions and debates in Gender Studies, both historical and contemporary. It draws on multiple disciplines – such as literature, history, economics, psychology, sociology, philosophy, political science, anthropology and media studies – to examine cultural assumptions about sex, gender, and sexuality. This course integrates analysis of current events through student presentations, aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with race, class, caste, nationality and other social identities. This course also seeks to build an understanding and initiate and strengthen programmes combating gender-based violence and discrimination. The course also features a number of exercises and reflective activities designed to examine the concepts of gender, gender-based violence, sexuality, and rights. It will further explore the impact of gender-based violence on education, health and development.

**ACTIVITIES:**

Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments.

**COURSE OBJECTIVES:**

- To sensitize students on issues of gender in contemporary India
- To provide a critical perspective on the socialization of men and women
- To expose the students to debates on the politics and economics of work
- To enable students to reflect critically on gender violence
- To expose students to more egalitarian interactions between men and women

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand important issues related to gender in contemporary India

**CO-2:** Attain a finer grasp of how gender discrimination works in our society and how to counter it

**CO-3:** Acquire insight into the gendered division of labour and its relation to politics and economics

**CO-4:** Respond to put an end to gender violence

**CO-5:** Equipped to work with the other gender treating them as equals

**MODULE 1: Introduction to Gender**

- ☐ Definition of Gender
- ☐ Basic Gender Concepts and Terminology
- ☐ Exploring Attitudes towards Gender
- ☐ Social Construction of Gender

## **MODULE 2: Gender Roles and Relations**

- ☐ Types of Gender Roles
- ☐ Gender Roles and Relationships Matrix
- ☐ Gender-based Division and Valuation of Labour

## **MODULE 3: Gender Development Issues**

- ☐ Identifying Gender Issues
- ☐ Gender Sensitive Language
- ☐ Gender, Governance and Sustainable Development
- ☐ Gender and Human Rights
- ☐ Gender and Mainstreaming

## **MODULE 4: Gender-based Violence**

- ☐ The concept of violence
- ☐ Types of Gender-based violence
- ☐ The relationship between gender, development and violence
- ☐ Gender-based violence from a human rights perspective

## **MODULE 5: Gender and Culture**

- ☐ Gender and Film
- ☐ Gender and Electronic Media
- ☐ Gender and Advertisement
- ☐ Gender and Popular Literature

## **MODULE 6: Gender and Studies**

- ☐ Knowledge: Through the Lens of Gender Point of View, Gender and the Structure of Knowledge
- ☐ Whose History: Questions for Historians and Others, Reclaiming a Past, Writing Other Histories

### **TEXT BOOK:**

1. Towards a World of Equals: A Bilingual Textbook on Gender, A. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu, Telugu Akademi, Telangana Government, 2015

### **REFERENCES:**

1. Sen, Amartya, More than One Million Women are Missing, New York Review of Books 37.20 (20 December 1990). Print. 'We Were Making History' Life Stories of Women in the Telangana People's Struggle. New Delhi: Kali for Women, 1989
2. Tripti Lahiri, By the Numbers: Where Indian Women Work, Women's Studies Journal (14 November 2012) Available online at: <http://blogs.wsj.com/India/real-time/2012/11/14/by-the-numbers-where-india-women-work/>&gt;
3. Abdulali Sohaila I Fought For My Life ...and Won Available online at:<http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/>
4. K. Kapadia, The Violence of Development: The Politics of Identity, Gender and Social Inequalities in India, London: Zed Books, 2002

# **OPEN ELECTIVE COURSES**

# **SMART CITIES**

## SMART CITIES

In the twenty-first century, engineers are being tasked with solving ever more complex and subtle societal challenges – from climate change to unprecedented urbanisation that is materially affecting the lives of many urban populations. As engineers become ever more interdisciplinary and the boundaries of disciplines soften, they need to reflect as a community as to the appropriateness of the engineering paradigm to address these needs. Currently the engineering community is pointing to the digital technologies and the 'smart city' as a deliverer of efficiency and resilience without fully acknowledging the intricate socio-political context in which it is situated.

The domain of EIE was developed to modernise and automate these operations using the technological advancements in the realm of electronics. Even outside the industry, common household appliances — such as washing machine, air-conditioner, geyser, and microwave oven — cannot attract customers without features such as auto cut-off after certain time or temperature, which is again an example of instrumentation. The field of Instrumentation Engineering is also core to the recent advances such as smart home appliances, smart cities and automobiles. It is thus not far from the truth to claim that the fourth industrial revolution.

The world population is continuously growing and reached a significant evolution of the society, where the number of people living in cities surpassed the number of people in rural areas. This puts national and local governments under pressure because the limited resources, such as water, electricity, and transports, must thus be optimized to cover the needs of the citizens. Therefore, different tools, from sensors to processes, service, and artificial intelligence, are used to coordinate the usage of infrastructures and assets of the cities to build the so-called smart cities.

Different definitions and theoretical models of smart cities are given in literature. However, smart city can usually be modelled by a layered architecture, where communication and networking layer plays a central role. In fact, smart city applications lay on collecting field data from different infrastructures and assets, processing these data, taking some intelligent control actions, and sharing information in a secure way. Thus, a two-way reliable communications layer is the basis of smart cities. This chapter introduces the basic concepts of this field and focuses on the role of communication technologies in smart cities. Potential technologies for smart cities are discussed, especially the recent wireless technologies adapted to smart city requirements.

### ***What is the concept of a smart city?***

There is no universally accepted definition for a smart city because people can interpret different meanings for it. Hence, it means different things to different people. Here, you will get a basic definition that captures the essence of what a smart city is and what it does. While the concept varies from area to area depending on the resources, the basic idea behind it remains the same. A smart city aims to bring various components together to live harmoniously and attempts to do with the least environmental damage or impact. In other words, a smart city is a place with high standards of living, which survives and thrives on eco-friendly means.

The size and amenities within a smart city vary according to geography, resources available, geopolitical scenario and investment received.

Growth in Global population continues to drive citizens from rural areas to cities. With rapid expansion of urban areas, cities need to become intelligent to handle this large scale urbanization. This is driving city operators to look at smarter ways to manage complexities, increase efficiencies and improve quality of life. Today we need cities that monitor & integrate infrastructure to better optimize resources while maximizing service to its citizens. So to meet all the needs we need our cities to be smarter which brings a concept "**Smart cities**" Smart cities optimize the use of technology in the design & operation of infrastructure and buildings in such a way which meets the current and future needs of their citizens. To be truly smart they also require consideration of governance & growth, urban development and infrastructure, the environment & natural resources, society and community.

Smart city programs provide a range of technologies that can be applied to solve infrastructure problems associated with ageing infrastructure and increasing demands. The potential for infrastructure and urban improvement remains unrealized, however, due to technical, financial, and social constraints and criticisms that limit the implementation of smart cities concepts for infrastructure management. The discussion presented here provides a review of smart technologies including sensors, crowdsourcing and citizen science, actuators, data transmission, Internet of Things, big data analytics, data visualization, and blockchain, which can be used for infrastructure management. Smart infrastructure programs are reviewed to explore how enabling technologies have been applied across civil engineering domains, including transportation systems, water systems, air quality, energy infrastructure, solid waste management, construction engineering and management, structures, and geotechnical systems.

Making cities "smarter" by efficient management of resources and infrastructure, greener environment, and smart governance resulting in a better quality of living of its citizens. This can be enabled by the effective use of information and communication technologies (ICTs) tools, which have the ability to provide eco-friendly and economically viable solutions for cities.

Setting up a smart city is more than improving the old system with technology by simply adding sensors, remote supervision, and control to essential city services. It should be a complete shift of a paradigm in daily life when using new technologies, especially new ICT leading to smart outcomes.

### **Smart solutions**

Another important feature of smart cities is that they will provide smart solutions to modern problems. These include:

- Public information systems
- Redressal of grievances
- Electronic service delivery
- Maximum engagement of citizens
- Reduced energy and fuel usage
- Reduces the development of wastes
- Smart water monitoring



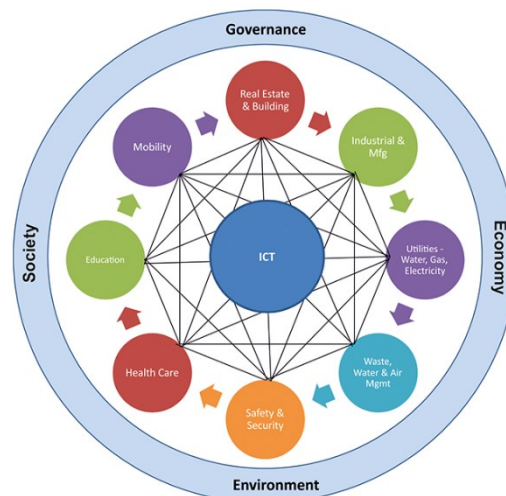
- Treatment of wastewater
- Sustainable monitoring water quality
- Maximum utilization of renewable energy sources
- Usage of green building techniques
- Smart parking to reduce clutter
- Intelligent traffic management system.

### **Advantages of a smart cities,**

1. Promotion of mixed land usage resulting in higher efficiency and reduced wastage of land.
2. Expanded housing opportunities.
3. Reduced congestion, air pollution and resource depletion.
4. Helps to boost local economies by promoting localized trade and interactions.
5. Efficient use of public transport to reduce fuel wastage.
6. Safe and secure localities.
7. Preservation of open spaces.
8. Reduction in urban heating.
9. Promotion of transit-oriented development.
10. Making governance more people-friendly and cost-effective.

Here's a look at some projects that have taken inspiration from the concepts used for the design of smart cities. These projects will help you build energy-efficient systems that will help heal the world.

1. **Home Automation using IoT**
2. **Smart Irrigation System**
3. **Smart Building using IoT**
4. **Smart Energy Meter using GSM**
5. **Solar and Smart Energy Systems**
6. **Smart Water Monitoring**
7. **Automated Street Lighting**
8. **Automated Railway Crossing**
9. **Intelligent Transportation Systems**
10. **Smart Sewage Maintenance Systems.**



To develop new smart cities and to transform our cities into smart cities the engineers in particular are stepping up as leaders.

**Civil & Environmental Engineers** are working to harness the potential of latest technologies and data for our urban infrastructure, which is among the most complex system in the world. They provide sustainable, resilient and advanced means of transportation system, green building, better water management system and better waste management system. This not only develop physical infrastructure but also develop institutional & social infrastructure that enable our societies to function. Modelling these systems of systems will require managing data at an unprecedented scale.

To support them Computer and **Electronics & Communication Engineers** help in creating future cities that are digital, build and operate cities ICT landscape across



application and infrastructure like IOT (Internet of Things), e-payment, e-market, the latest communication devices etc which is leveraging next generation technologies. They create a platform for conveyance of different city services, leverage big data analytics to manage city performance and proactive crisis management.

**Electrical Engineers** developing new renewable source of energy to meet ever increasing power demands. They also develop methods of effective power transmission with minimum losses which is more economical and safer. They also work on developing microchips to micro sensors which are helping in making our households, institution efficient and safer.

### **Conclusion**

It is clear that dreaming of a smart city without active contribution of engineers is a myth. So, there will always be demand of Engineers and because of which even after crises in the placement scenario still the maximum science students choose Engineering as their first career choice in hope of a better future.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

B.Tech. V Semester

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(A19OE1CE01) SMART CITIES PLANNING AND DEVELOPMENT

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To Introduce students on smart city basic concepts, global standards and Indian context of smart cities
- To understand smart community, smart transportation and smart buildings
- To understand energy demand, green approach to meet energy demand and their capacities
- To identify smart transportation technologies in cities and concepts towards smart city

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Recognize smart city concepts and their international and national standards

**CO-2:** Recognize smart community, transportation and building concepts

**CO-3:** Develop and calibrate energy demand and their capacity limits

**CO-4:** Predict the various smart urban transportation systems and the transition from existing city towards a smart city

**UNIT – I:**

**Introduction to Smart Urban Infrastructures and Smart Cities:** Introduction to City Planning - Understanding Smart Cities - Dimensions of Smart Cities - Global Experience of Smart Cities – Global Standards and Performance Benchmarks, Practice Codes -Indian scenario - India “100 Smart Cities” Policy and Mission.

**UNIT – II:**

**Smart Cities Planning and Development:** Introduction to Smart Community - Smart community concepts: Concept of Smart Community - Smart Transportation - Smart Building and Home Device - Smart Health - Smart Government - Smart Energy and Water – Cyber Security, Safety, and Privacy - Internet of Things, Blockchain, Artificial Intelligence, Alternate Reality, Virtual Reality.

**UNIT – III**

**Smart Urban Energy Systems – I:** Conventional vs. Smart, City components, Energy demand, Green approach to meet Energy demand, Index of Indian cities towards smartness – A statistical analysis -Meeting energy demand through direct and indirect solar resources - Efficiency of indirect solar resources and its utility, Capacity limit for the indirect solar resources - Effectiveness in responsive environment in smart city; Smart communication using green resources.

**UNIT – IV:**

**Smart Urban Energy Systems – II:** Introduction to PV technology - PV of various scale for smart city applications - Energy efficiency - Policies of Solar PV in smart domains (RPO, REC, Carbon credit, etc.) Definition, Structure of Smart Grid- Indian Perspective- Advantage & limitation.

**UNIT – V:**

**Smart Urban Transportation Systems:** Smart Transportation Technologies - Driverless and connected vehicles - Ride sharing solutions - The "improve" pathway - The "shift" pathway – Smart Roads and Pavement systems.

**UNIT – VI:**

**Towards Smart Cities:** The transition of legacy cities to Smart -. Right transition process - The benefit of citizens, cities to adopt effective management and governance approaches - Factors in the transition phase of legacy cities to smart cities and their managerial implications.

**TEXT BOOKS:**

1. Internet of Things in Smart Technologies for Sustainable Urban Development, G. R. Kanaga Chidambaresan, R. Maheswar, V. Manikandan, K. Ramakrishnan, Springer, 2020
2. Society 5.0: A People-centric Super-smart Society, Hitachi-U, Tokyo Laboratory (H-U Tokyo Lab), Springer, 2020
3. The Routledge Companion to Smart Cities, Katharine S. Willis, Alessandro Aurigi, Routledge International Handbooks, 2020

**REFERENCES:**

1. Smart Cities in Asia: Governing Development in the Era of Hyper-Connectivity Yu-min Joo, Yu-Min Joo, Teck-Boon Tan, Edward Elgar Pub, 2020
2. Urban Systems Design: Creating Sustainable Smart Cities in the Internet of Things Era, Yoshiki Yamagata, Perry P. J. Yang, Elsevier, 2020
3. Smart Cities and Artificial Intelligence: Convergent Systems for Planning, Design, and Operations, Christopher Grant Kirwan, Zhiyong Fu, Elsevier, 2020

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**(A19OE1CE02) GREEN BUILDING TECHNOLOGY**

**COURSE PRE-REQUISITES:** Smart Cities Planning and Development

**COURSE OBJECTIVES:**

- To expose the students to green buildings, their features and importance in the present context of sustainable development
- To introduce various sustainable building materials for green buildings
- To acquire knowledge on various design concepts and construction aspects of green buildings
- To learn the various policies and incentives for green buildings and also different green building rating systems and codes

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Explain the importance, features and requisites of a green building

**CO-2:** Identify suitable sustainable building materials for construction of green building

**CO-3:** Plan and design various systems for green buildings

**CO-4:** Explain various codal provisions of green buildings and accordingly rate a building

**UNIT – I:**

**Introduction:** Definition of Green Buildings - Typical features of green buildings - Benefits of Green Buildings - Green Building Materials and Equipment in India - Key Requisites for Constructing a Green Building - Important Sustainable features for Green Building - Climate responsive buildings - Carbon footprint and eco footprints of buildings.

**UNIT – II:**

**Green Building Materials:** Introduction to sustainable building materials – Sustainable Concrete – Partial replacements in concrete - Natural building materials - Bio materials - Mycelium - Engineered Wood - Structural insulated panels (SIPs) - Natural Fiber - Nontoxic materials: low VOC paints, organic paints, coating and adhesives - Use of waste materials such as paper, Cellulose, glass bottles, tires, shipping containers - Use of industrial waste such as fly-ash, bags, building demolition waste.

**UNIT – III:**

**Design of Green Buildings:** Indoor environmental quality requirement and management: Thermal comfort - HVAC - Visual perception - Illumination requirement - Auditory requirement – Energy Efficiency - Lighting and day lighting - Steady and non-steady heat transfer through the glazed window and the wall – Indoor air

quality - Local climatic conditions – temperature, humidity, wind speed and direction.

#### **UNIT – IV:**

**Construction of Green Buildings:** IoT Integrated Automated Building Systems - Synthetic Roof Underlayment - Green Roofs - Grid Hybrid System - Passive Solar - Greywater Plumbing Systems - Electrochromic Glass - Solar Thermal Cladding - Structural 3D Printing - Self-healing Concrete - Bird Friendly Design - Landscaping for Parking Lot Runoff - Composting Toilets - Proactive Maintenance - Green Cleaning.

#### **UNIT – V:**

**Green Building Policies and Incentives:** Green products and material certification - parameters making products green - products transparency movement - Cradle to cradle certification - Product emission testing - Carbon trust - carbon credit - returns on investments - savings Policies towards electrical power in India – Case study - Tax credits & Grants - Green construction guide.

#### **UNIT – VI:**

**Green Building Rating Systems and Codes:** Green building rating systems: BREAM, LEED and GRIHA, ISO 14020 – Green building codes: ECBC and NBC 2016 - Green materials: Standard specifications – Case Studies: Dockland Building in Hamburg, SOKA Building in Wiesbaden, KSK Tuebingen, Nycomed, Constance, DR Byen, Copenhagen.

#### **TEXT BOOKS:**

1. Green Building Handbook, Tom Woolley and Sam Kimings, 2009
2. Sustainable Construction: Green Building Design and Delivery, Charles J. Kibert, 2012

#### **REFERENCES:**

1. Green Building Fundamentals-II, Mike Montoya, Pearson, 2010
2. Sustainable Construction - Green Building Design and Delivery, Charles J. Kibert, John Wiley & Sons, 2008
3. Sustainable Construction and Design-II, Regina Leffers, Pearson / Prentice Hall, 2009
4. Introduction to Environmental Economics, Nick Hanley, Jason, F. Shogren and Ben White, Oxford University Press, 2001

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

B.Tech. VII Semester

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(A19OE1CE03) SMART MATERIALS AND STRUCTURES

**COURSE PRE-REQUISITES:** Smart Cities Planning and Development, Green Building Technology

**COURSE OBJECTIVES:**

- To introduce the students to various smart materials and their working principles
- To acquire knowledge on different measuring techniques
- To learn about various smart sensors, actuators and their application in structural health monitoring
- To acquire knowledge on different smart composite materials and their modelling concepts
- To learn about the data acquisition and processing and their application in engineering domain

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Explain the different smart materials and their principles

**CO-2:** Explain and understand different measuring techniques

**CO-3:** Identify suitable smart sensors and actuators for a specific engineering application

**CO-4:** Gain the knowledge on data acquisition and processing and advantages in smart materials and smart structures

**UNIT – I:**

**Introduction:** Introduction to Smart Materials and Structures – Instrumented structures functions and response – Sensing systems – Self-diagnosis – Signal processing consideration – Actuation systems and effectors.

**UNIT – II:**

**Measuring Techniques:** Measuring techniques: Strain Measuring Techniques using Electrical strain gauges, Types – Resistance – Capacitance – Inductance – Wheatstone bridges – Pressure transducers – Load cells – Temperature Compensation – Strain Rosettes.

**UNIT – III:**

**Sensors:** Sensing Technology – Types of Sensors – Physical Measurement using Piezo Electric Strain measurement – Inductively Read Transducers – LVDT – Fiber optic Techniques- Absorptive chemical sensors – Spectroscopes – Fibre Optic Chemical Sensing Systems and Distributed measurement, Application of Smart Sensors for Structural Health Monitoring (SHM), System Identification using Smart Sensors

#### **UNIT – IV:**

**Actuators:** Actuator Techniques – Actuator and actuator materials – Piezoelectric and Electrostrictive Material – Magneto structure Material – Shape Memory Alloys – Electro rheological fluids – Electromagnetic actuation – Role of actuators and Actuator Materials - IPMC and Polymeric Actuators, Shape Memory Actuators

#### **UNIT-V:**

**Signal Processing and Control Systems:** Data Acquisition and Processing – Signal Processing and Control for Smart Structures – Sensors as Geometrical Processors – Signal Processing – Control System – Linear and Non-Linear

#### **UNIT –VI:**

**Advances in Smart Structures & Materials:** Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials, Autophagous Materials, Self-Healing Polymers, Intelligent System Design, Emergent System Design

#### **TEXT BOOKS:**

1. Smart Materials and Structures, Gandhi M. V. and Thompson B. S., Chapman & Hall, Madras, 1992
2. Dynamics and Control of Structures, Meirovitch L., John Wiley, 1992

#### **REFERENCES:**

1. Smart Structures: Analysis and Design, A. V. Srinivasan, D. Michael McFarland, Cambridge University Press, 2009
2. Smart Materials and Technologies: For the Architecture and Design Professions, Michelle Addington and Daniel L. Schodek, Routledge, 2004
3. Smart Structures and Materials, Brian Culshaw, Artech House – Borton, 1996





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B.Tech. VIII Semester

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(A19OE1CE04) INTELLIGENT TRANSPORTATION SYSTEM

**COURSE PRE-REQUISITES:** Smart Cities Planning and Development, Green Building Technology, Smart Materials and Structures

**COURSE OBJECTIVES:**

- To understand ITS architecture and standards
- To apply appropriate ITS technology depending upon site specific conditions
- To design and implement ITS components
- To understand concept and application of Automated Highway Systems

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Differentiate different ITS user Services

**CO-2:** Apply ITS for road user safety

**CO-3:** Interpret importance of AHS in ITS

**CO-4:** Extend future research and special project

**UNIT – I:**

**Introduction To ITS:** System Architecture, Standards, Database – Tracking Database – Commercial Vehicle Operations – Intelligent Vehicle Initiative - Metropolitan ITS – Rural ITS – ITS for Rail network.

**UNIT – II:**

**ITS Travel Management:** Autonomous Route Guidance System – Infrastructure based systems – Telecommunications – Vehicle – Roadside communication – Vehicle Positioning System – Electronic Toll Collection – Electronic Car Parking

**UNIT – III:**

**ITS Designs:** Modeling and Simulation Techniques - Peer – to – Peer Program – ITS for Road Network – System Design – Mobile Navigation Assistant – Traffic Information Center – Public Safety Program.

**UNIT – IV:**

**Introduction to Automated Highway Systems:** Evolution of AHS and Current Vehicle Trends - Vehicles in Platoons – Aerodynamic Benefits - Integration of Automated Highway Systems – System Configurations - Step by Step to an Automated Highway System.

**UNIT – V:**

**Evaluation and Assessment of AHS:** Spacing and Capacity for Different AHS Concepts – Communication Technologies for AHS - The Effects of AHS on the Environment – Regional Mobility - Impact Assessment of Highway Automation.

**UNIT – VI:**

**Implementation of ITS:** ITS programs globally- overview of ITS in developed countries and developing countries – ITS at Toll Plazas – Parking lots – Highways.

**TEXT BOOKS:**

1. Intelligent Transport Systems Handbook: Recommendations for World Road Association (PIARC), Kan Paul Chen, John Miles, 2000
2. Intelligent Transport Systems – Cases and Policies, Roger R. Stough, Edward Elgar, 2001
3. Intermodal Freight Transport, David Lowe, Elsevier Butterworth-Heinemann, 2005

**REFERENCES:**

1. Positioning Systems in Intelligent Transportation Systems, Chris Drane and Chris Rizos, Artech House Publishers, 2000
2. Perspectives on Intelligent Transport Systems, Joseph M. Sussman, Springer, 2000
3. Intelligent Transport System, Intelligent Transportation Primer, 2001

# **WASTE MANAGEMENT**

## **WASTE MANAGEMENT**

The courses such as solid waste management (SWM), hazardous waste management (HWM), waste to energy (WTE) and intelligent waste management and recycling system (IWM&RS) are the courses available in the waste management track stream which having a potential syllabus content to meet out the industrial and research needs.

Solid waste management is an interesting track course which actual highlights the day-to-day problems where everybody is facing due to the improper management of industrial, domestic and household waste. Further, the enthusiastic aspects involved in the track courses such as: awareness on its impact over on environment, formal or scientific way of handling and management of waste and disposal scenarios.

In hazardous waste management course, handling and management of nuclear waste at national and international level have been highlighted. Further, the content enlightens about the legal process of state, central and industrial responses toward any emergency situations arise by hazardous waste. Finally, it deals about natural resource damage assessment and restoration.

Waste to energy is a pioneering course available in the track; it is one of the interesting and mindboggling course in the track which highlights the importance of converting the waste materials into wealth. It gives enough space to understand the basic process technologies in a theoretical and industrial way such as: thermal, chemical and biological conversion process. From the above, biological conversion process is in its embryonic state and having potential to expands its technological wings in the near future and having enormous scope of industrial applications where students can be benefited. Finally, conversion devices is an innovative module have been framed to explore the young minds in the line of designing and creating a demand based conversion device products which even lays an entrepreneurial pathway to them.

First of its kind, even at both international and national level a dedicated and extensive course for intelligent waste management and recycling system have been framed with conventional and advanced modules. It is really an interesting course where a student can apply his/her innovative creations to solve the existing and futuristic problems in a smart way with the help of smart tools. Optimistic modules such as: life cycle assessment and carbon-footprint-based IWMS, principles of systems engineering and regulatory frameworks have been incorporated to meet out the international requirements.

In the pathway of exploring the fundamentals and basic knowledges about the course, the six units of all the courses have been formulated keeping in the mind that the students can be able to competitive among the international community at the end of semester. In this context, comprehensive theoretical and industrial processes have been incorporated in each and every module of courses. Further, it is highly believed that the framed syllabus modules having 100% industrial applications which can make the students to feel motivated, satisfied and confidence to compete with the international community.

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(A19OE1CE05) SOLID WASTE MANAGEMENT

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To understand the concepts of solid waste management
- To remember the characteristics of solid waste and source reduction techniques
- To acquire the knowledge & skills in the collection, storage, transport and engineering principles of solid waste
- To remember and Understand the treatment, disposal and recycling and various laws and regulation of solid waste management

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Apply the fundamental concepts of solid waste management

**CO-2:** Apply the acquired knowledge to resolve the practical problems on source reduction

**CO-3:** Apply the knowledge on collection, storage, transport and waste processing of solid waste in real time situation

**CO-4:** Impart the gained knowledge and skills and various laws & regulations on treatment of SW in real time societal problems

**UNIT – I:**

**Sources and Classification:** Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management – Elements of integrated waste management and roles of stakeholders - Financing and Public Private Participation for waste management- Integrated solid waste management.

**UNIT – II:**

**Waste Characterization and Source Reduction:** Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – waste sampling and characterization plan - Source reduction of wastes –Waste exchange - Extended producer responsibility - Recycling and reuse.

**UNIT – III:**

**Storage, Collection and Transport of Wastes:** Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport.

#### **UNIT – IV:**

**Waste Processing Technologies:** Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes- treatment of biomedical wastes - Health considerations in the context of operation of facilities.

#### **UNIT – V:**

**Waste Disposal:** Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – Rehabilitation of open dumps-remediation of contaminated sites.

#### **UNIT – VI:**

**Regulatory Frameworks:** Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes, plastics waste, bio-medical waste, construction and demolition waste and fly ash waste.

#### **TEXT BOOKS:**

1. Integrated Solid Waste Management, George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, McGraw-Hill International Edition, 1993
2. CPHEEO, Manual on Municipal Solid Waste Management, Central Public Health and Environmental Engineering Organization, Government of India, 2014

#### **REFERENCES:**

1. Handbook of Solid Waste Management, Frank Kreith, George Tchobanoglous, McGraw-Hill, 2002
2. Waste Management Practices, John Pichtel, CRC Press, Taylor and Francis Group, 2014
3. Municipal Solid Waste Management, Processing, Energy Recovery, Global Examples, P. Jayarama Reddy, BS Publications, CRC Press, Taylor and Francis Group, 2011
4. Gol, Ministry of Environment and Forest and Climate Change, Various Recent Laws and Rules of Solid Waste Management

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**(A19OE1CE06) HAZARDOUS WASTE MANAGEMENT**

**COURSE PRE-REQUISITES:** Solid Waste Management

**COURSE OBJECTIVES:**

- To understand the concepts of hazardous waste management
- To understand the principle of waste characterization, storage, transport and processing
- To understand the principles of nuclear waste and Hazardous Management (HM) and emergency Response
- To understand the principle and process of landfills and natural resource Damage Assessment & Restoration

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Apply the fundamental concepts of hazardous waste management

**CO-2:** Apply the knowledge to resolve the problems on storage, transport and processing

**CO-3:** Apply the knowledge to resolve the practical problems on nuclear waste and HM & emergency response

**CO-4:** Impart the gained knowledge and skills to resolve the practical problems on landfills and natural resource damage assessment & restoration on field

**UNIT – I:**

**Introduction:** Need for hazardous waste management – Sources of hazardous wastes – Effects on community – terminology and classification – Storage and collection of hazardous wastes – Problems in developing countries – Protection of public health and the environment.

**UNIT – II:**

**Waste Characterization, Storage, Transport and Processing:** Hazardous Waste Characterization and Definable Properties - Analytical- Analytical methods – Hazardous waste inventory- Source reduction of hazardous wastes - Handling and storage of Hazardous wastes –Waste Compatibility Chart – Hazardous Waste Transport- Manifest system – Transboundary movement of wastes – Basal Convention – Hazardous waste treatment technologies – Physical, chemical and thermal treatment of hazardous waste – Solidification – Chemical fixation – Encapsulation – Incineration.

**UNIT – III:**

**Nuclear Waste:** Characteristics – Types – Nuclear waste – Uranium mining and processing – Power reactors – Refinery and fuel fabrication wastes – spent fuel –



Management of nuclear wastes – Decommissioning of Nuclear power reactors – Health and environmental effects.

#### **UNIT – IV:**

**Management of Hazardous Wastes:** Identifying a hazardous waste – methods – Quantities of hazardous waste generated – Components of a hazardous waste management plan – Hazardous waste minimization – Disposal practices in Indian Industries – Future challenges - Emergency Response - National Response Team and Regional Response Teams; National Contingency Plan and Regional Contingency Plans; National Response Center; State, Local and Industry Response Systems.

#### **UNIT – V:**

**Secure Landfills:** Hazardous waste landfills – Site selections – landfill design and operation – Regulatory aspects – Liner System- Liners: clay, geomembrane, HDPE, geonet, geotextile – Cover system- Leachate Collection and Management – Environmental Monitoring System- Landfill Closure and post closure care - Underground Injection Wells.

#### **UNIT – VI:**

**Natural Resource Damage Assessment and Restoration:** Natural Resource Damage Assessment Laws and Regulations - Central and State government agencies - Damage Assessment and Restoration Procedures - Groundwater Hydrology and Contamination Processes - Groundwater Contamination Detection, Analysis and Monitoring - Overview of CERCLA - Remedial Action Process and RCRA Correction Action Program - Preliminary Assessments and Site Inspections - Hazard Ranking System - National Priorities List - State Priorities List - Remedial Investigations and Feasibility Studies - Records of Decision and the Administrative Process - Remedial Design - Remedial Action - NPL Deletion Process.

#### **TEXT BOOKS:**

1. Hazardous Waste Management, Charles A. Wentz., 2<sup>nd</sup> Edition, McGraw-Hill International, 1995
2. Standard Handbook of Hazardous Waste Treatment and Disposal, Harry M. Freeman, McGraw-Hill, 1997

#### **REFERENCES:**

1. Hazardous Waste (Management and Transboundary Movement) Rules, Ministry of Environment and Forests, Government of India
2. Guidelines and Criteria for Hazardous Waste Landfills and Hazardous Waste Treatment Disposal Facilities, Central Pollution Control Board, 2010
3. Hazardous Waste Management, Prof. Anjaneyulu
4. Hazardous Waste Management, M. LaGrega and others, McGraw-Hill Publication

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B.Tech. VII Semester

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### (A19OE1CE07) WASTE TO ENERGY

**COURSE PRE-REQUISITES:** Solid Waste Management, Hazardous Waste Management

#### **COURSE OBJECTIVES:**

- To understand the concepts of energy from waste
- To understand the principle and process of thermal conversion technology (TCT)
- To understand the principle and process of chemical and biological conversion technology (CCT & BCT)
- To understand the principles and processes of biomass energy technology (BET) and conversion process and devices (P&D) for solid wastes

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Apply the fundamental concepts of energy from waste

**CO-2:** Apply the acquired knowledge to resolve the practical problems on TCT

**CO-3:** Apply the knowledge to resolve the practical problems on CCT and BCT

**CO-4:** Impart the gained knowledge and skills to resolve the practical problems on BET and P&D

#### **UNIT – I:**

**Introduction to Energy from Waste:** Classification of waste as fuel – agro based, forest residue, industrial waste, MSW – conversion devices – incinerators, gasifiers, digesters, Environmental monitoring system for land fill gases, Environmental impacts; Measures to mitigate environmental effects due to incineration.

#### **UNIT – II:**

**Thermal Conversion Technologies:** Fundamentals of thermal processing – combustion system – pyrolysis system – gasification system – environmental control system – energy recovery system – incineration.

#### **UNIT – III:**

**Chemical Conversion Technologies:** Acid & Alkaline hydrolysis – hydrogenation; solvent extraction of hydrocarbons; solvolysis of wood; biocrude; biodiesel production via chemical process; catalytic distillation; transesterification methods; Fischer-Tropsch diesel: chemicals from biomass - various chemical conversion processes for oil, gas, cellulose acetate.

#### **UNIT – IV:**

**Biological Conversion Technologies:** Nutritional requirement for microbial growth – types of microbial metabolism – types of microorganisms – environmental requirements – aerobic biological transformation – anaerobic biological

transformation – aerobic composting – low solid anaerobic digestion – high solid anaerobic digestion – development of anaerobic digestion processes and technologies for treatment of the organic fraction of MSW – Biodegradation and biodegradability of substrate; biochemistry and process parameters of biomethanation - other biological transformation processes.

#### **UNIT – V:**

**Biomass Energy Technologies:** Biomass energy resources – types and potential; Energy crops - Biomass characterization (proximate and ultimate analysis); Biomass pyrolysis and gasification; Biofuels – biodiesel, bioethanol, Biobutanol; Algae and biofuels; Pellets and bricks of biomass; Biomass as boiler fuel; Social, economic and ecological implications of biomass energy.

#### **UNIT – VI:**

**Conversion Devices:** Combustors (Spreader Stokes, Moving grate type, fluidized bed), gasifier, digesters. Briquetting technology: Production of RDF and briquetted fuel. Properties of fuels derived from waste to energy technology: Producer gas, Biogas, Ethanol and Briquettes – conversion process with basic device formulation for agricultural residues and wastes including animal wastes; industrial wastes; municipal solid wastes; E-waste; Bio-medical waste; C&D waste; plastic waste and batteries waste.

#### **TEXT BOOKS:**

1. Integrated Solid Waste Management, George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, McGraw-Hill International Edition, 1993
2. Energy from Waste - An Evaluation of Conversion Technologies, C. Parker and T. Roberts, Elsevier Applied Science, London, 1985

#### **REFERENCES:**

1. Introduction to Biomass Energy Conversion, Capareda S., CRC Press, 2013
2. Thermo-chemical Processing of Biomass: Conversion into Fuels, Chemicals and Power, Brown RC and Stevens C, Wiley and Sons, 2011
3. Biomass Conversion Processes for Energy and Fuels, Sofer, Samir S. (Ed.), Zaborsky, R. (Ed.), Plenum Press, 1981
4. Energy Recovery from Municipal Solid Waste Thermal Conversion Technologies, P. Jayarama Reddy, CRC Press, Taylor & Francis Group, 2016

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B.Tech. VIII Semester

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**(A19OE1CE08) INTELLIGENT WASTE MANAGEMENT SYSTEM AND RECYCLING SYSTEM**

**COURSE PRE-REQUISITES:** Solid Waste Management, Hazardous Waste Management, Waste to Energy

**COURSE OBJECTIVES:**

- To understand the concepts of Solid waste
- To understand the principle and process of IWMS Tools
- To understand the applications of IoT, ML, DL, BC and LCA & Carbon Foot Print (CFP) based SWM
- To understand the principles of Process Systems Engineering (PSE) and various laws and regulation of SWM

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Apply the fundamental concepts of Solid waste

**CO-2:** Apply the knowledge to resolve the practical problems with the help of IWMS Tools

**CO-3:** Apply the knowledge of IoT, ML, DL, BC and LCA & CFP to resolve the practical problems in SWM

**CO-4:** Impart the PSE knowledge and various laws and regulation to resolve the practical problems in SWM

**UNIT – I:**

**Introduction to Solid Waste:** Sources, Generation, Classification and Types of Solid Waste – Biomedical Waste – E-Waste – Construction and Demolition Waste – Plastic Waste – Batteries Waste – Hazardous Waste - Waste Management Through Waste Hierarchy: Reduce, Reuse, Recycle, Recover, and Disposal - Waste Operational Units: Equipment and Facilities: Collection and Transportation - Mechanical Treatment - Biological Treatment - Thermal Treatment – Disposal.

**UNIT – II:**

**Introduction to IWMS Tools:** Introduction – Need of the IWMS – functional elements of IWMS – Ultrasonic Sensor, Arduino Board, GSM Module, Bread Board, Power Supply (Battery) – Jump Wires - Navigation system – Cloud Services - Zero Waste Principle.

**UNIT – III:**

**Applications in Intelligent Waste Management System:** Introductory Applications of IoT, Machine Learning, Deep Learning and Block Chain Technology in Waste Characterization and Source Reduction, Storage, Collection and Transport of Wastes, Waste Processing Technologies and Waste Disposal.

#### **UNIT – IV:**

**Life Cycle Assessment and Carbon-Footprint-Based IWMS:** Phases of Life Cycle Assessment: Goal and Scope Definition - Life Cycle Inventory - Life Cycle Impact Assessment – Interpretation - LCA Waste Management Software - Umberto Software - SimaPro Software - LCA Assessment Methodology: Life Cycle Inventory Analysis - Life Cycle Impact Assessment – Interpretation - Sensitivity Analysis - Carbon-Footprint-Based SWM - The Global-Warming Potential Impact - GHG Accounting - GWP Assessment for Solid Waste Management.

#### **UNIT – V:**

**Principles of Systems Engineering:** Systems Engineering Principles and Tools for SWM - Planning Regional Material Recovery Facilities - Optimal Planning for Solid Waste Collection, Recycling, and Vehicle Routing - Multiattribute Decision Making with Sustainability Considerations - Decision Analysis for Optimal Balance between Solid Waste Incineration and Recycling Programs - Environmental Informatics for Integrated Solid Waste Management - Future Perspectives.

#### **UNIT – VI:**

**Regulatory Frameworks:** Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes, plastics waste, bio-medical waste, construction and demolition waste and fly ash waste.

#### **TEXT BOOKS:**

1. Sustainable Solid Waste Management - A Systems Engineering Approach, Ni-Bin Chang and Ana Pires, IEEE & John Wiley, Hoboken, 2015
2. Integrated Solid Waste Management, George Tchobanoglous, Hilary Theisen and Samuel A. Vigil, McGraw-Hill International Edition, 1993

#### **REFERENCES:**

1. Manual on Municipal Solid Waste Management, CPHEEO, Central Public Health and Environmental Engineering Organization, Government of India, 2014
2. Smart Waste Management- Nutshell, Vishal Gupta, Amazon.com Services LLC, 2017
3. Recyclable Household Waste Management System for Smart Home in IOT, Manpreet Kaur & Dr. Kamaljit Singh Saini, Independently, 2018
4. GoI, Ministry of Environment and Forest and Climate Change, Various Recent Laws and Rules of Solid Waste Management

# **GREEN ENERGY**

## 1. RENEWABLE ENERGY SOURCES

### What we are studying?

The climate landscape is changing rapidly, and new technologies and solutions keep arising to respond to global and local challenges.

Renewable energy sources course makes you discover how Solar Thermal Energy conversion system works. It makes you understand how a Solar Photo voltaic generation system generates electricity. Scope of the course also includes wind energy generation. It also navigates you through Biomass and geo thermal energy generation systems.

### Job opportunities:

When it comes to the hottest and most buzzing careers in the 21st century, the majority of people think of hardcore technical domains such as data science, machine learning & artificial intelligence. Few people might also come up with biotechnology (or biosciences). But, quite often people forget about one of the dark horses – the Renewable Energy sector. Even [Bill Gates lobbied for the Energy sector as one of the top three career choices for making an impactful career.](#)

### Reference:

<https://www.stoodnt.com/blog/careers-in-renewable-energy-job-opportunities-fields-of-study-and-top-universities/>

## 2. RENEWABLE ENERGY TECHNOLOGIES

Within Crisis, there are seeds of opportunity..! We are at the wedge of fossil fuel end. After few years you can witness fuel crisis all over the world, as an engineer one must aware of the solution. To design sustainable systems those last for decades, one must use renewable energy as main or auxiliary source of energy. The application may be electrical or mechanical or chemical, one must convert energy from renewable source into electricity for ease of use.

Renewable Energy Technologies course will introduce you to Different types of Solar PV systems and their characteristics. Students will know the functionality of Power Converters such as Inverters etc., through block diagram approach. Fuel cell technology, which is one of the solutions for energy crisis will be discussed in detail. Course will conclude by discussing impact of PV panel production on environment and disposal of it.

### Job Opportunities:

Green jobs in the renewable energy sector are expected to touch new figures with 6 digit monthly income. Following link may describe the interesting interdisciplinary careers for budding engineers.

### Reference:

<https://www.businessinsider.in/slideshows/miscellaneous/21-high-paying-careers-for-people-who-want-to-save-the-planet-and-also-have-job-security/slidelist/70677782.cms#slideid=70677804>

## 3. ENERGY STORAGE TECHNOLOGIES

Battery technology is an essential skill for every engineer in present scenario. Course on energy storage technologies will enable student to, Design storage

system Residential loads integrated to Renewable and storage systems for Electric Vehicles. It will make student to understand various electrochemical storages such as Lead acid, Li Ion cell etc. and their characteristics. The course enables student to compare non-electric, electric storage systems and analyze application of them to various domains.

**Job opportunities:**

Upon successful completion of course student will enhance the chances of getting into EV industry, which almost open fact. Job Profiles include

- i. Battery algorithms engineer
- ii. Battery management engineer
- iii. Battery modeling expert
- iv. Design engineer – EV

**4. ENERGY MANAGEMENT AND CONSERVATION**

Energy Management And Conservation course is mainly intended to monitor Energy consumption of industries and to manage energy systems. This course also deals with methods of improving efficiency of electric machinery and to design a good illumination system. It also teaches student calculate pay back periods for energy saving equipment.



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**(A19OE1EE01) RENEWABLE ENERGY SOURCES**

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To understand the role of solar power
- To know components of PV system conversion
- To learn operation of windmills
- To understand the principle operation of biomass and geo thermal energy systems

**COURSE OUT COMES:** After completion of the course, the student should be able to

**CO-1:** Understand Solar Thermal Energy conversion systems

**CO-2:** Understand Solar Photo voltaic systems

**CO-3:** Analyze wind energy conversion system

**CO-4:** Understand the principle operation of Biomass and geo thermal energy systems

**UNIT – I:**

**Principles of Solar Radiation:** Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, The apparent motion of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sunshine, solar radiation data.

**UNIT – II:**

**Solar Thermal Energy Conversion:**

**Solar Heating:** Some basic calculations, The performance of solar heating devices, Evaluation of sunlight received by a collector, Flat solar panels - Different technologies of thermal solar collectors-Evaluation of the performance of solar collectors- Selective coatings for collectors and glazing, Solar heating systems - Individual and collective solar water heaters- Combined solar systems for the heating of buildings

**Power Stations:** Concentric Solar Power Plants- Concentrating systems- Components for production of heat and conversion into electricity

**UNIT – III:**

**Solar PV Conversion:** The PV Cell-Crystalline Solar cells-Thin film solar cell, Module, Array, Equivalent Electrical circuit, Open circuit voltage and Short circuit current, I-V, P-V Curves, Array design- Sun angle- effect of Temperature-Sun tracking, PV system components

**UNIT – IV:**

**Wind Energy:** Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria, Maximum power Tracking of wind mills, and peak power operation Site selection of Wind mills, working Induction generator (Principle only)

**UNIT – V:**

**Bio-Mass:** Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation and economic aspects.

**UNIT – VI:**

**Geothermal & Ocean Energy:** Resources, types of wells, methods of harnessing the energy (brief discussion) potential in India. OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

**TEXT BOOKS:**

1. Non-Conventional Energy Sources, G. D. Rai, Khanna Publishers
2. Renewable Energies, John Claude Sabbonedere, ISTE & John Wiley, 2007
3. Renewable Energy Resources, Twidell & Wier, CRC Press (Taylor & Francis), 2016

**REFERENCE:**

1. Wind & Solar Power Systems, Mukund R. Patel, CRC Press, 2003

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**(A19OE1EE02) RENEWABLE ENERGY TECHNOLOGIES**

**COURSE PRE-REQUISITES:** Renewable Energy Sources

**COURSE OBJECTIVES:**

- To provide necessary knowledge about the modeling, design and analysis of various PV systems
- To show that PV is an economically viable, environmentally sustainable alternative to the world's energy supplies
- To understand the power conditioning of PV and WEC system's power output

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Model, analyze and design various photovoltaic systems

**CO-2:** Know the feasibility of PV systems as an alternative to the fossil fuels

**CO-3:** Design efficient stand alone and grid connected PV and WEC power systems

**UNIT – I:**

**Behavior of Solar Cells-Basic Structure and Characteristics:** Types - equivalent circuit-modeling of solar cells including the effects of temperature, irradiation and series/shunt resistances on the open-circuit voltage and short-circuit current-Solar cell arrays- PV modules-PV generators- shadow effects and bypass diodes- hot spot problem in a PV module and safe operating area.

**UNIT – II:**

**Types of PV Systems:** Grid connected PV systems- Net-metering- Estimation of actual a.c. output power from PV systems

Stand-alone system- Approach to designing an off-grid PV system with battery- with battery and diesel generator- Stand-alone solar water pumping system- Sizing/designing PV water pumping system- Problems

**UNIT – III:**

**Power Converters for PV and Wind:** Basic switching devices, AC-DC Rectifier, DC-AC inverter (Basic operation), DC DC converter - Buck, Boost converters Basic operation, Battery charger (Basic operation), grid interface requirements in Renewable energy integration

**UNIT – IV:**

**Maximum Power Point Tracking:** Various Sources of Losses in PV system, Charge Control in Battery Backed PV Systems, Maximum Power Point Tracking (MPPT)- Role of DC-DC converter in MPP tracking- Perturb and Observe Method-pseudo program

for P&O method, Advanced Issues & Algorithms- search steps-variable step size algorithm.

**UNIT – V:**

**Fuel Cell Technology:** History of Fuel cells, Fuel Cell Vehicle Emissions, Hydrogen safety factors, Principle of Operation- Fuel cell Model- cell voltage, Power and efficiency of fuel cell, Various types of fuel cells, Various storage systems for Hydrogen, Applications

**UNIT – VI:**

**Solar Thermal Electricity Generation:** Sterling Engine, Solar Pond, Solar Chimney  
**Solar PV System Environment Impact:** Potential Hazards in production of PV cell, Energy payback and CO<sub>2</sub> emission of PV systems, Procedure for decommissioning of PV plant, Future Trends of Wind Energy system

**TEXT BOOKS:**

1. Handbook of Renewable Energy Technology, Ahmed F. Zobaa, World Scientific Publishing Company, 2011
2. Wind and Solar Power Systems Design, Analysis, and Operation, Patel M. R., 2<sup>nd</sup> Edition, CRC Press, New York, 2005
3. Practical Handbook of Photovoltaics - Fundamentals and Applications, Augustin McEvoy, Tom Markvart, T. Markvart, L. Castaner, Elsevier Science, 2003

**REFERENCE:**

1. Electric Powertrain - Energy Systems, Power Electronics & Drives for Hybrid, Electric & Fuel Cell Vehicles, Goodarzi, Gordon A., Hayes, John G., John Wiley & Sons, 2018

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B.Tech. VII Semester

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(A19OE1EE03) ENERGY STORAGE TECHNOLOGIES

**COURSE PRE-REQUISITES:** Renewable Energy Sources, Renewable Energy Technologies

**COURSE OBJECTIVES:**

- To understand Techno economic analysis of various storage systems
- To know Feasibility of different storage technologies
- To learn Operation of several electrochemical storage systems
- To understand Functionality of non-electric storage systems

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Design storage system Residential loads integrated to Renewable and storage systems for Electric Vehicles

**CO-2:** Understand various electrochemical storage system

**CO-3:** Understand terminology and characteristics of Electro chemical systems

**CO-4:** Compare non-electric and electric storage system

**CO-5:** Analyze application of storage systems to various domains

**UNIT – I:**

**Techno-economic Analysis of Various Energy Storage Technologies:** Electrical Energy Storage (EES)-Definition-Role, Energy storage components, Applications and Technical support, Financial Benefits of EES, Techno economic analysis, Classification of Energy Storage systems, Comparison

**UNIT – II:**

**Estimation of Energy Storage and Feasibility Analysis:** Background-Solar Power-Wind Power (Brief discussion), Estimation-daily residential load-daily available solar energy-daily available wind energy-Importance, Estimation of Storage sizing- Steps for Storage sizing- Grid connected residential PV-grid connected residential Wind-hybrid system, Feasibility analysis of Storage systems- Various Terms involved- Case study of comparison between Off grid and grid connected systems

**UNIT – III:**

**Electro Chemical Storage:** Standard Batteries- Lead Acid- VRLA - Ni-cd, Modern Batteries- Ni MH- Li Ion, Flow Batteries – Br<sub>2</sub> Zn-Vanadium Redox, Battery composition, construction, Principle of operation, Types, Advantages and disadvantages to above batteries.

**UNIT – IV:**

**Terminology & Characteristics:** Battery Terminology, Capacities, Definitions of various characteristics, Different States of charge-DOD-SOC-SOE-SOH-SOF, Resistance, Battery Design, Battery Charging, Charge Regulators, Battery Management, General Equivalent Electrical Circuit, Performance Characteristics

**UNIT – V:**

**Non-Electric Storage Technologies:** Flywheel, Energy Relations, Flywheel System Components, Benefits of Flywheel over Battery, Superconducting Magnet Energy Storage, Compressed Air Energy storage, Overview Thermal Energy Storage. Capacitor bank storage, Comparison of storage Technologies

**UNIT –VI:**

**Applications:** Domains of applications of Energy storage- Starter-Traction-stationary-mobile or nomadic, Review of storage requirements, Storage for Electric Vehicle application, Storage for hybrid vehicle-Regenerative Braking-Super capacitor-hybrid capacitor

**TEXT BOOKS:**

1. Energy Storage Technologies and Applications, Ahmed Faheem Zobaa, InTech Publishers, 2013
2. Lithium Batteries and Other Electrochemical Storage Systems, Christian Glaize, Sylvie Geniès, ISTE & John Wiley, 2013
3. Wind and Solar Power Systems, Mukund R. Patel, 2<sup>nd</sup> Edition, CRC Press, 2006

**REFERENCES:**

1. Rechargeable Batteries Applications Handbook, EDN Series for Design Engineers, Elsevier

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B.Tech. VIII Semester

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(A19OE1EE04) ENERGY MANAGEMENT AND CONSERVATION

**COURSE PRE-REQUISITES:** Renewable Energy sources, Renewable Energy Technologies, Energy Storage Technologies

**COURSE OBJECTIVES:**

- To understand the necessity of conservation of Energy
- To Know the methods of Energy management
- To identify the factors to increase the efficiency of electrical equipment
- To know the benefits of carrying out energy Audits

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** To conduct Energy Audit of industries

**CO-2:** To manage energy Systems

**CO-3:** To specify the methods of improving efficiency of electric motor

**CO-4:** To improve power factor and to design a good illumination system

**CO-5:** To calculate pay back periods for energy saving equipment

**UNIT – I:**

**Basic Principles of Energy Audit:** Energy audit- definitions, concept, types of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit

**UNIT – II:**

**Energy Management:** Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manager, Qualities and functions, language, Questionnaire - check list for top management

**UNIT – III:**

**Energy Efficient Motors:** Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics - variable speed, variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit

**UNIT – IV:**

**Power Factor Improvement, Lighting and Energy Instruments:** Power factor – methods of improvement, location of capacitors, p.f with non-linear loads, effect of harmonics on p.f., p.f motor controllers – simple problems

**UNIT – V:**

**Lighting Energy Audit and Energy Instruments:** Good lighting system design and practice, lighting control, lighting energy audit - Energy Instruments- watt meter, data loggers, thermocouples, pyrometers, flux meters, tongue testers, application of PLC's

**UNIT – IV:**

**Economic Aspects and Analysis:** Economics Analysis-Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis.

**UNIT – VI:**

**Analysis of Energy Efficient Motor:** Energy efficient motors- calculation of simple payback method, net present worth method- Power factor correction, lighting - Applications of life cycle costing analysis, return on investment.

**TEXT BOOKS:**

1. Energy Management, W. R. Murphy & G. Mckay, Butterworth-Heinemann
2. Energy Management, Paul o' Callaghan, 1<sup>st</sup> Edition, McGraw-Hill, 1998

**REFERENCES:**

1. Energy Efficient Electric Motors, John C. Andreas, 2<sup>nd</sup> Edition, Marcel Dekker Inc., 1995
2. Energy Management Handbook, W. C. Turner, John Wiley and Sons
3. Energy Management and Good Lighting Practice: Fuel Efficiency Booklet12, EEO



# **3D PRINTING AND DESIGN**

## **3D PRINTING AND DESIGN**

3D Printing is a process for making a physical object from a three-dimensional digital model by laying down many successive thin layers of a material. It brings a digital CAD model into its physical form by adding layer by layer of materials. Thus called 'Additive Manufacturing'. It is the opposite of subtractive manufacturing i.e., removing material from an object using a mechanical machine. It enables to produce complex shapes using less material than traditional manufacturing methods. There are several different techniques to 3D print an object. It saves time through prototyping and is also responsible for manufacturing impossible shapes. Due to these, it has many applications in different fields like consumer products (eyewear, footwear, design, furniture, industrial products (manufacturing tools, prototypes, functional end-use parts, dental products, prosthetics, architectural scale models, reconstructing fossils, replicating ancient artefacts, reconstructing evidence in forensic pathology etc.

3D printing has good prospects from career perspective. Various positions that could be available are CAD designers, engineers, technical developers, software developers, electronics engineers, etc.

This OE track consists of 04 courses and is designed with an objective to provide an overview of all the constituents of 3D Printing starting from elements of CAD that are needed to create CAD models, followed by basics of 3D Printing required for setting the parameters, then the machines and tools used in 3D Printing for thorough understanding of systems and processes and finally the reverse engineering of 3D printing models from actual objects.

B.Tech. V Semester

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(A19OE1ME01) ELEMENTS OF CAD

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To understand the basics of CAD and devices used
- To know the various types of modeling used in CAD
- To appreciate the concept of feature-based modeling and geometric transformations
- To comprehend the assembly modeling procedure and data exchange formats

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Know the fundamentals of CAD and devices used

**CO-2:** Identify the types of CAD modeling techniques and utilize them

**CO-3:** Evaluate the objects or models using geometric transformations and manipulations

**CO-4:** Perform the assembly modeling and assess the various data exchange formats

**UNIT – I:**

**Fundamentals of CAD:** Introduction to Computer Aided Design (CAD), Design process, Application of computers for Design and Manufacturing, Benefits of CAD, Brief overview of computer peripherals for CAD.

**UNIT – II:**

**Geometric Modeling:** Introduction to Geometric Model, Types of modeling, Curve representation

**Wireframe Modeling:** Introduction, advantages, limitations and applications, Wire frame entities-analytic and synthetic, Basic definitions of Cubic, Bezier and B-spline curves

**UNIT – III:**

**Surface Modeling:** Introduction, advantages, limitations and applications, surface entities, Basic definitions of analytic surfaces - planar surface, ruled surface, tabulated cylinder, surface of revolution; Basic definitions of synthetic surfaces - Bezier surface, B-spline surface

**UNIT – IV:**

**Solid Modeling:** Introduction, advantages, limitations and applications, Solid Entities, Solid Representation schemes – Boundary Representation (B-Rep) scheme, Constructive Solid Geometry (CSG) scheme.

Feature-based Modeling: Introduction, Feature entities, Feature representation, 3D Sketching, Parameter, Relations and Constraints

**UNIT – V:**

**Geometric Transformations:** Introduction to 2D & 3D transformations, Brief treatment on Translation, Scaling, Reflection and Rotation using Homogeneous and concatenated transformations

**Manipulations:** Displaying, Segmentation, Trimming, Intersection, Projection

**UNIT – VI:**

**Assembly Modeling:** Introduction, Assembly modeling, Assembly Tree, Mating Conditions, Bottom-up and Top-down approach

**Product Data Exchange:** Introduction, Graphics Standards, Types of translators, Importance of formats in 3D Printing, Data exchange formats - IGES, STEP and STL

**TEXT BOOKS:**

1. CAD/CAM Theory and Practice, Ibrahim Zeid, Tata McGraw-Hill
2. Mastering CAD/CAM, Ibrahim Zeid, Tata McGraw-Hill
3. CAD/CAM-Computer Aided Design and Manufacturing, Mikell P. Groover, E. W. Zimmers, Pearson Education/Prentice Hall

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B.Tech. VI Semester

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(A19OE1ME02) INTRODUCTION TO 3D PRINTING

**COURSE PRE-REQUISITES:** Elements of CAD

**COURSE OBJECTIVES:**

- To understand the need of 3D Printing
- To understand about the process chain involved in 3D Printing
- To know about the two-dimensional layer by layer techniques, solid based systems & 3D Printing data exchange formats
- To know the post processing methods involved in 3D Printing

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Summarize the importance of 3D Printing

**CO-2:** Explain the process chain involved in 3D Printing

**CO-3:** Explain about two-dimensional layer-by-layer techniques, solid based systems and 3D printing data exchange formats

**CO-4:** Apply the knowledge gained in the post-processing methods

**UNIT – I:**

**Introduction to 3D Printing:** Introduction to 3D Printing, 3D Printing evolution, Classification of 3D Printing, Distinction between 3D Printing & CNC Machining, Advantages of 3D Printing

**UNIT – II:**

**Generalized 3D Printing Process Chain:** Process chain, Materials for 3D Printing, Design for 3D Printing and Overview of Medical Modeling & Reverse Engineering.

**UNIT – III:**

**Two-Dimensional Layer-By-Layer Techniques:** Stereolithography (SL), Selective Laser Sintering (SLS), Selective Powder Building (SPB), Advantages and Applications.

**UNIT – IV:**

**Solid Based Systems:** Introduction, basic principles, Fused Deposition Modeling, Multi-Jet Modeling, Laminated Object Manufacturing (LOM), Advantages and Applications.

**UNIT – V:**

**3D Printing Data Exchange Formats:** STL Format, STL File Problems, Brief Overview of other translations like IGES File, HP/GL File and CT data only.

**UNIT – VI:**

**Post-Processing:** Introduction, Support Material Removal, Surface Texture Improvements, Accuracy Improvements, Aesthetic Improvements.

**TEXT BOOKS:**

1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker, Springer, 2010
2. Rapid Prototyping: Principles & Applications, Chuaa Chee Kai, Leong Kah Fai, World Scientific, 2010

**REFERENCES:**

1. Rapid Prototyping: Theory and Practice, Ali K. Karmani, Emand Abouel Nasr, Springer, 2006
2. Understanding Additive Manufacture: Rapid Prototyping, Rapid Tooling and Rapid Manufacture, Andreas Gebhardt, Hanser Publishers, 2013
3. Rapid Manufacturing: Advanced Research in Virtual and Rapid Prototyping, Hopkinson, N. Haque, and Dickens, Taylor and Francis, 2007

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B.Tech. VII Semester

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(A19OE1ME03) 3D PRINTING-MACHINES, TOOLING AND SYSTEMS

**COURSE PRE-REQUISITES:** Elements of CAD, Introduction to 3D Printing

**COURSE OBJECTIVES:**

- To understand the need of prototyping
- To understand about the liquid and solid based 3D printing systems
- To know about the liquid-based 3D printing systems & rapid tooling
- To know the applications of 3D Printing

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Summarize the importance of 3D Printing

**CO-2:** Explain the process involved in liquid and solid based 3D printing systems

**CO-3:** Explain about the liquid-based 3D printing systems and rapid tooling

**CO-4:** Adapt the knowledge gained in applications of 3D Printing

**UNIT – I:**

**Introduction:** Prototype Fundamentals, Types of Prototypes, Roles of Prototypes, Phases of Development Leading to Rapid Prototyping, Fundamentals of Rapid Prototyping.

**UNIT – II:**

**Liquid Based 3D Printing Systems:** Introduction, Principles, Processes and Applications of Solid Ground Curing, Material Jetting & Binder Jetting

**UNIT – III:**

**Solid Based 3D Printing Systems:** Introduction, Principles, Processes and Applications of Fused Deposition Modelling (FDM), Paper Lamination Technology (PLT) and Laminated Object Manufacturing (LOM)

**UNIT – IV:**

**Laser Based 3D Printing Systems:** Selective Laser Sintering (SLS)-Principle, Process and Applications, Three-Dimensional Printing- Principle, Process and Applications, Laser Engineered Net Shaping (LENS)- Principle, Process and Applications

**UNIT – V:**

**Rapid Tooling:** Introduction and need for Rapid Tooling, Overview of Indirect and Direct Processes, Applications

**UNIT – VI:**

**3D Printing Applications:** Brief overview of Applications in Design, Engineering, Aerospace Industry, Automotive Industry and Biomedical Industry

**TEXT BOOKS:**

1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker, Springer, 2010
2. Rapid Prototyping: Principles & Applications, Chuaa Chee Kai, Leong Kah Fai, World Scientific, 2010

**REFERENCES:**

1. Rapid Prototyping: Theory and Practice, Ali K. Karmani, Emand Abouel Nasr, Springer, 2006
2. Understanding Additive Manufacture: Rapid Prototyping, Rapid Tooling and Rapid Manufacture, Andreas Gebhardt, Hanser Publishers, 2013
3. Rapid Manufacturing: Advanced Research in Virtual and Rapid Prototyping, Hopkinson, N. Haque, and Dickens, Taylor and Francis, 2007



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B.Tech. VIII Semester

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**(A19OE1ME04) REVERSE ENGINEERING**

**COURSE PRE-REQUISITES:** Elements of CAD, Introduction to 3D Printing, 3D Printing Machines, Tooling & Systems

**COURSE OBJECTIVES:**

- To understand the Reverse Engineering (RE) and its methodologies
- To comprehend data acquisition techniques for reverse engineering
- To understand Integration Between Reverse Engineering and Additive manufacturing
- To know the applications of reverse engineering

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Basic understanding of Reverse Engineering and its methodologies

**CO-2:** Understanding the data acquisition techniques for reverse engineering

**CO-3:** Understanding of amalgamation Between Reverse Engineering and Additive manufacturing

**CO-4:** Adapt the knowledge gained in reverse engineering for various applications

**UNIT – I:**

**Introduction to Reverse Engineering:** Need, Definition, The Generic Process, History of Reverse Engineering, Overview of Applications

**UNIT – II:**

**Methodologies and Techniques:** Potential for Automation with 3-D Laser Scanners, Computer-aided (Forward) Engineering, Computer-aided Reverse Engineering, Computer Vision and Reverse Engineering

**UNIT – III:**

**Data Acquisition Techniques:** Contact Methods: Coordinate Measurement Machine and Robotic Arms

**UNIT – IV:**

**Data Acquisition Techniques:** Noncontact Methods: Triangulation, Structured Light and Destructive Method

**UNIT – V:**

**Integration Between Reverse Engineering and Additive manufacturing:** Modeling Cloud Data, Integration of RE and AM for Layer-based Model Generation, Adaptive Slicing Approach for Cloud Data Modeling.

**UNIT – VI:****Applications:**

**Automotive:** Workflow for Automotive Body Design, Reverse Engineering for Better Quality

**Aerospace:** RE in Aerospace–A Work in Progress, Reducing Costs of Hard Tooling

**Medical:** Orthodontics, Hearing Instruments, Knee Replacement

**TEXT BOOKS:**

1. Reverse Engineering: An Industrial Perspective, V. Raja and K. Fernandes, Springer-Verlag
2. Reverse Engineering, K. A. Ingle, McGraw-Hill
3. Rapid Prototyping, Ali Kamrani, Emad Nasr, Springer, 2006

**REFERENCES:**

1. Smart Product Engineering, Michael Abramovici, Rainer Stark, Springer-Berlin Heidelberg
2. Product Design: Techniques in Reverse Engineering and New Product Development, K. Otto and K. Wood, Prentice Hall, 2001

# **INTERNET OF THINGS**

## INTERNET OF THINGS

**Internet of Things:** The IoT creates opportunities for more direct integration of the physical world into computer-based systems, resulting in efficiency improvements, economic benefits, and reduced human exertions. *IoT is changing how we live, work, travel, and do business. It is even the basis of a new industrial transformation, known as Industry 4.0, and key in the digital transformation of organizations, cities, and society overall.* The IoT track helps students to learn about how to

- Learn different protocols and connectivity technologies used in IOT.
- Expose the various sensors and transducers for measuring mechanical quantities.
- Develop simple applications using 8051 microcontrollers.
- Understand the key routing protocols for sensor networks and their design issues.

**Some of the more common career paths in the Internet of Things path are**

- IoT Developer. ...
- IoT Architect...
- IoT Embedded Systems Designer...
- IoT Solutions Engineer...
- Professional in Sensors and Actuators...
- Embedded Programs Engineer...
- Safety Engineer...

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| <b>(A19OE1EC01) SENSORS TRANSDUCERS AND ACTUATORS</b> |          |              |          |

**COURSE PRE-REQUISITES:** Engineering Physics, Electronic Measuring Instruments

**COURSE OBJECTIVES:**

- To expose the students to various sensors and transducers for measuring mechanical quantities
- To make the students familiar with the specifications of sensors and transducers
- To make the students identify for various sensors and transducers for various applications
- To expose the students to various actuators

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Familiar with classification and characteristics of various sensors and transducers

**CO-2:** Familiar with the principle and working of various sensors and transducers

**CO-3:** Familiar with the principle and working of various actuators

**CO-4:** Able to select proper Transducer / Sensor for a specific measurement application

**CO-5:** Able to select proper Actuator for a specific measurement application

**UNIT – I:**

**Primary Sensing Elements and Transducers:** Mechanical devices as primary detectors, mechanical spring devices, pressure sensitive primary devices, flow rate sensing elements, Transducers-electrical Transducers, classification of Transducers, characteristics and choice of Transducers, factors influencing the choice of Transducers.

**UNIT – II:**

**Electric Transducers:** Resistive transducers, Potentiometers, Strain gauges, Types of Strain gauges, Resistance thermometers, Thermistors, Thermocouples, variable Inductance Transducers, Linear Variable Differential Transformer, Synchros, Resolvers, Capacitive Transducers, Piezo electric Transducers.

**UNIT – III:**

**Magnetic & Optical Transducers:** Hall Effect Transducers, Magneto resistors, Magneto-Elastic and Magneto-Strictive Transducers, Opto electronic Transducers, Digital Encoding Transducers, Photo Optic Transducers.

#### **UNIT – IV:**

**Smart Sensors & Applications:** Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, the Automation. Sensors Applications: Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing, Sensors for environmental Monitoring.

#### **UNIT – V:**

**Mechanical and Electrical Actuators:** Mechanical Actuation Systems-Types of motion, Kinematic chains, Cams, Gears, Ratchet and pawl, Belt and chain drives, Bearings, Mechanical aspects of motor selection, Electrical Actuation Systems, Electrical systems, Mechanical switches, Solid-state switches, Solenoids, D.C. Motors, A.C. Motors, Stepper motors.

#### **UNIT – VI:**

**Pneumatic and Hydraulic Actuators:** Pneumatic and Hydraulic Actuation Systems-Actuation systems, Pneumatic and hydraulic systems, Directional Control valves, Pressure control valves, Cylinders, Servo and proportional control valves, Process control valves, Rotary actuators.

#### **TEXT BOOKS:**

1. A Course in Electrical and Electronic Measurements and Instrumentation, A. K. Sawhney, Puneet Sawhney, 19<sup>th</sup> Edition, 2011
2. Sensors and Transducers, D. Patranabis, 2<sup>nd</sup> Edition, PHI, 2013
3. Mechatronics, W. Bolton, Pearson Education Limited, 7<sup>th</sup> Edition, 2018

#### **REFERENCES:**

1. Sensors and Actuators, Patranabis, 2<sup>nd</sup> Edition, PHI, 2013

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

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**(A19OE1EC02) INTRODUCTION TO MICROCONTROLLER AND INTERFACING**

**COURSE PRE-REQUISITES:** Sensors Transducers and Actuators

**COURSE OBJECTIVES:**

- To differentiate various number systems
- To understanding programming concepts
- To develop simple applications using 8051 microcontrollers

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand basic computing concepts

**CO-2:** Know architecture of 8051 microcontrollers

**CO-3:** Program internal resources of 8051 microcontroller

**CO-4:** Interface peripherals to 8051 microcontroller

**UNIT – I:**

**Introduction to Computing:** Numbering and Coding Systems: Binary, Decimal, Hexadecimal and conversions, Binary and Hexadecimal Arithmetic, Complements, Alphanumeric codes. Digital Premier, Inside the Computer

**UNIT – II:**

**Embedded System Design:** Embedded system - Definition, Characteristics of embedded computing applications, Design challenges, Requirements, Specification, Architecture design, Designing hardware and software components, system integration, Design example: Model train controller.

**UNIT – III:**

**8051 Microcontroller:** Microcontrollers and Embedded Processors, Architecture and Programming Model of 8051, Special Function Register formats, Memory Organization, Timers and Counters- Operating modes, Serial port, Interrupts

**UNIT – IV:**

**8051 Programming in C:** Data types, software delay generation, Logical operations, Accessing code and data space in 8051, I/O port programming, Timer/counter programming.

**UNIT – V:**

**8051 Programming:** Serial IO modes and their programming in C, interrupts programming in C: serial, timer and external interrupts.

**UNIT – VI:**

**Introduction to Arduino:** Features of Arduino, Arduino components and IDE, Interfacing: Seven Segment Display, Pulse Width Modulation, Analog Digital Converter, Wireless connectivity to Arduino. Case study: From BT To WiFi: Creating WiFi Controlled Arduino Robot Car.

**TEXT BOOKS:**

1. The 8051 Microcontroller: Programming, Architecture, Ayala & Gadre, Cengage Publications 3<sup>rd</sup> Edition, 2008
2. The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, 2<sup>nd</sup> Edition, 2005

**REFERENCES:**

1. Digital Design, Morris Mano, PHI, 3<sup>rd</sup> Edition, 2006
2. Embedded Systems: Architecture, Programming and Design, 2<sup>nd</sup> Edition, TMH



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B.Tech. VII Semester

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(A19OE1EC03) FUNDAMENTALS OF INTERNET OF THINGS

**COURSE PRE-REQUISITES:** Sensors Transducers and Actuators, Introduction to Microcontrollers and Interfacing

**COURSE OBJECTIVES:**

- To understand the basics of Internet of Things
- To learn about IOT and M2M
- To understand Cloud of Things
- To learn different applications with IoT

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand the concepts of Internet of Things

**CO-2:** Understand the IOT, M2M

**CO-3:** Understand the concepts Cloud of Things

**CO-4:** Apply IOT to different applications in the real world

**UNIT – I:**

**Introduction to Internet of Things:** Definition and Characteristics of IoT, Physical Design of IoT, Logical Design of IoT-IoT Functional Blocks, IoT Communication Models, IoT Communication API's

**UNIT – II:**

**IoT Enabling Technologies:** Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Deployment Templates

**UNIT – III:**

**IoT Platforms Design Methodology:** Introduction, IoT Design Methodology- Purpose & Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specification, IoT Level Specifications, Functional view Specification, Operational View Specification, Device & component Integration, Application Development

**UNIT – IV:**

**IoT and M2M:** Introduction, M2M, Difference between IoT and M2M – Communication Protocols, Machines in M2M Vs things in IoT, Hardware Vs Software emphasis, Data collection and analysis, applications, SDN and NFV for IoT

**UNIT – V:**

**Cloud of Things:** Grid/SOA and Cloud Computing – Cloud Middleware – Cloud Standards – Cloud Providers and Systems – Mobile Cloud Computing – The Cloud of Things Architecture.

**UNIT – VI:**

**Domain Specific Applications of IoT:** Applications of IoT– Home, Health, Environment, Energy, Agriculture, Industry and Smart City.

**TEXT BOOKS:**

1. Internet of Things: A Hands-On Approach, Vijay Madisetti, Arshdeep Bahga, Universities Press, 2015
2. The Internet of Things – Key Applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi, Wiley, 2012
3. The Internet of Things in the Cloud: A Middleware Perspective, Honbo Zhou, CRC Press, 2012

**REFERENCES:**

1. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Ovidiu Vermesan, Peter Friess, River Publishers, 2013
2. Building the Internet of Things, Sara Cordoba, Wimer Hazenberg, Menno Huisman, BIS Publishers, 2011
3. Designing the Internet of Things, Adrian Mcewen, Hakin Cassimally, John Wiley and Sons, 2015

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(A19OE1EC08) WIRELESS SENSOR NETWORKS

**COURSE PRE-REQUISITES:** Sensors Transducers and Actuators, Introduction to Microcontrollers and Interfacing, IoT Protocols and its applications

**COURSE OBJECTIVES:**

- To expose basic concepts of wireless sensor network technology
- To study medium access control protocols and various issues in a physical layer
- To understand the key routing protocols for sensor networks and their design issues
- To understand sensor management in networks and design requirements

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Appreciate various design issues of wireless sensor networks

**CO-2:** Understand the hardware details of different types of sensors and select the application specific sensor

**CO-3:** Understand radio standards and communication protocols to be used for wireless sensor networks

**UNIT – I:**

**Introduction:** Overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

**UNIT – II:**

**Hardware:** Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): TinyOS, MANTIS, Contiki, and RetOS.

**UNIT – III:**

**Programming Tools:** C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet, NetSim)

**UNIT – IV:**

**Overview of Sensor Network Protocols (Details of at least 2 important protocol per layer):** Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi- hop and cluster-based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.

**UNIT – V:**

**Data Dissemination and Processing:** Differences compared with other database management systems, Query models, In-network data aggregation, data storage; query processing.

**UNIT – VI:**

**Specialized Features:** Energy preservation and efficiency; security challenges; Fault tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.

**TEXT BOOKS:**

1. Wireless Sensor Networks Technology, Protocols, and Applications, Kazem Sohraby, Daniel Minoli, Taieb Znati, John Wiley & Sons, 2007
2. Protocols and Architectures for Wireless Sensor Networks, H. Karl and A. Willig, John Wiley & Sons, India, 2012
3. Wireless Sensor Networks, C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, 1<sup>st</sup> Indian Reprint, Springer Verlag, 2010

**REFERENCES:**

1. Wireless Sensor Networks: An Information Processing Approach, F. Zhao and L. Guibas, 1<sup>st</sup> Indian Reprint, Morgan Kaufmann, 2013
2. Wireless Sensor Network and Applications, Yingshu Li, My T. Thai, Weili Wu, Springer Series on Signals and Communication Technology, 2008
3. Principles of Mobile Communications, Gordon L. Stuber, Springer International, 2<sup>nd</sup> Edition, 2001

**AUGMENTED  
REALITY (AR) /  
VIRTUAL REALITY  
(VR)**

## **AUGMENTED REALITY (AR) / VIRTUAL REALITY (VR)**

**Augmented Reality and virtual Reality (AR & VR):** Augmented reality (AR) and Virtual Reality (VR) bridge the digital and physical worlds. They allow you to take in information and content visually, in the same way you take in the world. AR dramatically expands the ways our devices can help with everyday activities like searching for information, shopping, and expressing yourself. VR lets you experience what it's like to go anywhere from the front row of a concert to distant planets in outer space.

### **Job Roles in Augmented Reality and Virtual Reality (AR & VR) Track**

- Design Architect. ...
- Software Designer. ...
- System Validation Engineers. ...
- Software Developer. ...
- 3D Artist...

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(A19OE1EC04) INTRODUCTION TO C-SHARP

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To understand the foundations of CLR execution
- To learn the technologies of the .NET framework and object-oriented aspects of C#
- To be aware of application development in .NET
- To learn web-based applications on .NET (ASP.NET)

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Explain how C# fits into the .NET platform

**CO-2:** Analyze the basic structure of a C# application

**CO-3:** Develop programs using C# on .NET

**CO-4:** Design and develop Web based applications on .NET

**UNIT – I:**

**Introduction to C#:** Introducing C#, Understanding .NET, overview of C#, Literals, Variables, Data Types, Operators, checked and unchecked operators, Expressions, Branching, Looping, Methods, implicit and explicit casting, Constant, Arrays, Array Class, Array List, String, String Builder, Structure, Enumerations, boxing and unboxing.

**UNIT – II:**

**Object Oriented Aspects of C#:** Class, Objects, Constructors and its types, inheritance, properties, indexers, index overloading, polymorphism, sealed class and methods, interface, abstract class, abstract and interface, operator overloading, delegates, events, errors and exception, Threading.

**UNIT – III:**

**Application Development on .NET:** Building windows application, Creating our own window forms with events and controls, menu creation, inheriting window forms, SDI and MDI application, Dialog Box (Modal and Modeless), accessing data with ADO.NET, DataSet, typed dataset, Data Adapter, updating database using stored procedures

**UNIT – IV:**

SQL Server with ADO.NET, handling exceptions, validating controls, windows application configuration.

**UNIT – V:**

**Web Based Application Development on .NET:** Programming web application with web forms, ASP.NET introduction, working with XML and .NET, Creating Virtual Directory and Web Application, session management techniques, web.config, web services, passing datasets, returning datasets from web services, handling transaction, handling exceptions, returning exceptions from SQL Server.

**UNIT – VI:**

**CLR and .NET Framework:** Assemblies, Versioning, Attributes, reflection, viewing meta data, type discovery, reflection on type, marshalling, remoting, security in .NET

**TEXT BOOKS:**

1. The Complete Reference: C# 4.0, Herbert Schildt, Tata McGraw-Hill, 2012
2. Professional C# 2012 with .NET 4.5, Christian Nagel et al., Wiley, 2012

**REFERENCES:**

1. Pro C# 2010 and the .NET 4 Platform, Andrew Troelsen, 5<sup>th</sup> Edition, A Press, 2010
2. Programming C# 4.0, Ian Griffiths, Matthew Adams, Jesse Liberty, 6<sup>th</sup> Edition, O'Reilly, 2010



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**(A19OE1EC05) INTRODUCTION TO SIGNAL PROCESSING**

**COURSE PRE-REQUISITES:** Introduction to C Sharp

**COURSE OBJECTIVES:**

- To understand various fundamental characteristics of signals and systems
- To analyze signals in frequency domain
- To know principles of signal transmission through systems
- To understand fundamentals of digital signal

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Classify signals and implement various operations on signals

**CO-2:** Analyze the characteristics of signals and systems

**CO-3:** Understand the basics of filter design

**CO-4:** Appreciate the processes of Multirate systems

**UNIT – I:**

**Representation of Signals:** Continuous time and Discrete Time signals, Classification of Signals – Periodic and aperiodic, even and odd, energy and power signals, deterministic and random signals, causal and non-causal signals, complex exponential and sinusoidal signals. Concepts of standard signals. Various operations on Signals.

**UNIT – II:**

**Representation of Systems:** Classification of discrete time Systems, impulse response, Concept of convolution in time domain and frequency domain, response of a linear system, System function, Signal bandwidth, system bandwidth. Ideal filter characteristics.

**UNIT – III:**

**Sampling Theorem:** Representation of continuous time signals by its samples - Sampling theorem – Reconstruction of a Signal from its samples, aliasing  
**Z –Transform:** Basic principles of z-transform, region of convergence, properties of ROC, Inverse z-transform using Partial fraction.

**UNIT – IV:**

**Introduction to Digital Signal Processing:** Applications of Z-Transforms- Solution of Linear Constant Coefficient Difference equations (LCCD), System function, Frequency Response of the system.

**UNIT – V:**

**Discrete Fourier Transforms:** Circular convolution, Comparison between linear and circular convolution, Computation of DFT.

**IIR Digital Filters:** Design of IIR Digital filters ( $H(s)$  to be given) - Impulse invariance transformation techniques, Bilinear transformation method.

**UNIT – VI:**

**FIR Digital Filters:** Characteristics of linear phase FIR filters and its frequency response, Comparison of IIR and FIR filters. Design of FIR filters using Fourier Method and Windowing Technique (only Hanning).

**Realization of IIR and FIR Filters:** Direct and Cascade forms.

**TEXT BOOKS:**

1. Signals, Systems and Communications, B. P. Lathi, BS Publications, 2009
2. Signals and Systems, Alan V. Oppenheim, Alan S. Willsky and S. Hamid Nawab, 2<sup>nd</sup> Edition, PHI
3. Digital Signal Processing: Principles, Algorithms and Applications, John G. Proakis, D. G. Manolakis, 4<sup>th</sup> Edition, Perason/PHI, 2009

**REFERENCES:**

1. Signals and Systems, Simon Haykin and Barry Van Veen, 2<sup>nd</sup> Edition, John Wiley
2. Signals, Systems and Transforms, C. L. Philips, J. M. Parr and Eve A. Riskin, 3<sup>rd</sup> Edition, Pearson, 2004
3. Signals and Systems, Schaum's Outlines, Hwei P. Hsu, Tata McGraw-Hill, 2004
4. Digital Signal Processing – A Practical Approach, Emmanuel C. Ifeacher, Barrie W. Jervis, 2<sup>nd</sup> Edition, Pearson Education

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B.Tech. VII Semester

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(A19OE1EC06) INTRODUCTION TO IMAGE AND VIDEO PROCESSING

**COURSE PRE-REQUISITES:** Introduction to C Sharp, Introduction to Signal Processing

**COURSE OBJECTIVES:**

- To introduce fundamentals of digital image and video processing
- To demonstrate digital signal processing techniques in spatial and frequency domains
- To study and compare various image and video compression algorithms
- To study applications of motion estimation in video processing

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Acquire, represent the digital image and transforms

**CO-2:** Apply various pixel position and intensity-based image processing techniques

**CO-3:** Understand and analyze the performance of block matching algorithms in MPEG video coding standards

**UNIT – I:**

**Fundamentals of Image Processing and Image Transforms:** Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels, 2 – D Discrete Fourier Transform, Discrete Cosine Transform, Introduction to Wavelet transforms.

**UNIT – II:**

**Image Enhancement-Spatial Domain Methods:** Point Processing, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters.

**UNIT – III:**

**Image Enhancement-Frequency Domain Methods:** Basics of filtering in frequency domain, Image Smoothing, Image Sharpening, Selective Filtering.

**Image Segmentation:** Segmentation Concepts, Point, Line and Edge Detection, Thresholding, Region Based Segmentation.

**UNIT – IV:**

**Image Compression:** Image compression fundamentals – coding Redundancy, spatial and temporal redundancy.

**Compression Models:** Lossy and Lossless, Huffmann coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding.

**UNIT – V:**

**Basic Steps of Video Processing:** Analog video, Digital Video, Time varying Image Formation models: 3D motion models, Geometric Image formation, Photometric Image formation, sampling of video signals.

**UNIT – VI:**

**2-D Motion Estimation:** Optical flow, pixel-based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Application of motion estimation in video coding.

**TEXT BOOKS:**

1. Digital Image Processing, Gonzalez and Woods, 3<sup>rd</sup> Edition, Pearson
2. Video Processing and Communication, Yao Wang, Joem Ostarmann and Ya – Quin Zhang, 1<sup>st</sup> Edition, PHI

**REFERENCES:**

1. Digital Video Processing, M. Tekalp, Prentice Hall International
2. Image Acquisition and Processing with LabVIEW, Relf, Christopher G., CRC Press
3. Inverse Synthetic Aperture Radar Imaging with MATLAB Algorithms, Aker Ozdemi R, John Wiley & Sons
4. Fundamentals of Digital Image Processing, A Practical Approach with Examples in Matlab, Chris Solomon, Toby Breckon, John Wiley & Sons

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(A19OE1EC07) FUNDAMENTALS OF AUGMENTED REALITY AND VIRTUAL REALITY

**COURSE PRE-REQUISITES:** Introduction to C Sharp, Introduction to Signal Processing, Introduction to Image & Video Processing

**COURSE OBJECTIVES:** Throughout the course, Students will be expected to develop AR VR applications by being able to do each of the following:

- To a review of current Virtual Reality (VR) and Augmented Reality (AR) technologies
- To the fundamentals of VR/AR modeling and programming
- To provides a detailed analysis of engineering scientific and functional aspects of VR/AR

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Acquire knowledge in main applications VR / AR technologies

**CO-2:** Analyze different tools for VR/AR applications

**CO-3:** Developing VR/AR applications

**UNIT – I:**

**Augmented Reality and Virtual Reality:**

**Augmented Reality:** Introduction to Augmented Reality (AR), Fundamentals, Chronicle order of AR, features

**Virtual Reality:** Introduction to Virtual Reality (VR), Features of VR and Chronicle order of VR; Difference between AR and VR.

**UNIT – II:**

**Types of Augmented Reality:** Marker based AR, Marker less AR, Projection based AR, Super Imposition based AR, Applications of AR.

**UNIT – III:**

**Types of Virtual Reality:** Non- immersive simulation, Semi-immersive simulations, Fully immersive simulations; Applications VR.

**UNIT – IV:**

**Making an AR App with Simple CUBE:** Introduction to Unity, Installation steps, Fundamentals while implementing Project, importing a cube, Create an account in Vuforia, license manager, target manager, downloading database and uploading target database in unity.

**UNIT – V:**

**AR App with Interaction:** Introduction to C#, Scripting interactive objects, implementation C# Script using unity, uploading target object, deploying application into ANDROID Device.

**UNIT – VI:**

**Creating an Virtual Reality:** Creating an Virtual Reality Scene in unity, adding colliders, Settings of Unity to make the application compatible with Google cardboard.

**TEXT BOOKS:**

1. Augmented Reality for Developers, Build Practical Augmented Reality Applications with Unity, ARCore, ARKit, and Vuforia. Linowes J., Babilinski K., United Kingdom, Packt Publishing, 2017
2. Building Virtual Reality with Unity and Steam VR, Murray, J. W., United Kingdom, CRC Press, 2020

**REFERENCES:**

1. Virtual Reality & Augmented Reality in Industry, Ma D., Gausemeier J., Fan X., Grafe M. (Eds.) Springer, 2011
2. Unity 2020 Virtual Reality Projects: Learn VR Development by Building Immersive Applications and Games with Unity 2019.4 and Later Versions, Linowes J., 3<sup>rd</sup> Edition, United Kingdom, Packt Publishing, 2020

# **ARTIFICIAL INTELLIGENCE**

## **ARTIFICIAL INTELLIGENCE**

Artificial Intelligence (AI) is a cognitive science with highly research activities in the major areas like Machine Learning, Robotics, Natural Language Processing and image processing. This track will cover basic foundations of artificial intelligence it will make the students industry-ready for artificial intelligence and data science job roles. Artificial intelligence is used in wide range of industrial applications such as healthcare, transportation, entertainment, insurance, transport and logistics, and customer service.

Future applications of AI would be utilized in automated transportation, cyborg technology, solving problems associated with climate change, deep-sea and space exploration.



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(A19OE1MT01) MATHEMATICS FOR ARTIFICIAL INTELLIGENCE

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To introduce the basic concepts of probability and matrices in the field of Artificial Intelligence
- To identify, explore the complex problem-solving strategies
- To develop problem solving skills related to algorithmic analysis required for AI
- To apply and build mathematical model to solve real-world problems

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Explore and demonstrate practical approaches related to implementation of the AI algorithms using probability concepts

**CO-2:** Formulate and solve the Artificial intelligence related problems by using the knowledge of matrices and vectors

**CO-3:** Demonstrate the understanding of mathematical ideas from artificial intelligence perspective and machine learning

**CO-4:** Analyze and solve the complexity of a given problem with suitable optimization techniques

**UNIT – I:**

**Probability:** Basic rules and axioms, events, sample space, frequentist approach, dependent and independent events, conditional probability, Random variables, continuous and discrete, expectation, variance, distributions - joint and conditional, Bayes' theorem, Popular distributions - Bernoulli, Binomial, Poisson, Normal.

**UNIT – II:**

**Descriptive Statistics & Linear Regression:** Classification and tabulation of univariate data, graphical representation, Frequency curves. Descriptive measures - Central tendency and Dispersion. Simple Linear Regression Models.

**UNIT – III:**

**Vector Space:** Vectors, definition, scalars, addition, scalar multiplication, inner product (dot product), vector projection, cosine similarity, orthogonal vectors, normal and orthonormal vectors, vector norm, vector space, linear combination, linear span, linear independence, basis vectors.

**UNIT – IV:**

**Matrices:** Matrices definition, rank, System of equations: Direct methods - LU decomposition method, Tri-diagonal system; Applications of linear systems - Network flows and Mechanical systems.

**UNIT – V:**

**Eigen Values & Eigen Vectors:** Eigen values & eigen vectors, concept, intuition, significance, how to find principle component analysis, concept, properties, applications, Singular value decomposition, concept, properties, applications.

**UNIT – VI:**

**Multivariate Calculus:** Functions, Scalar derivative, partial derivatives, Gradient, chain rule, properties, method for derivative of vector-valued function with respect to scalar, vector four combinations - Jacobian, Hessian, Gradient of vector valued function, Gradient of matrices. Local/global maxima and minima, saddle point, convex functions, gradient descent algorithms - Learning rate, momentum, stochastic, Constrained optimization (Lagrange Multiplier method), convex optimization.

**TEXT BOOKS:**

1. Mathematics for Machine Learning, Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong, Cambridge University Press, 2020
2. Linear Algebra and it's Applications, David C. Lay, 3<sup>rd</sup> Edition, Pearson Publications
3. Probability and Statistics for Engineers, Richard A. Johanson, 5<sup>th</sup> Edition, Prentice-Hall, 1995

**REFERENCES:**

1. Math for Machine Learning: Open Doors to Data Science and Artificial Intelligence, Richard Han, 2018
2. Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning, James V. Stone
3. Advanced Engineering Mathematics, Erwin Kreyszig, 9<sup>th</sup> Edition, John Wiley & Sons, 2006

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(A19OE1CS01) FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE

**COURSE PRE-REQUISITES:** Mathematics for Artificial Intelligence

**COURSE OBJECTIVES:**

- To understand and analyze the importance and basic concepts of artificial intelligence and the use of agents
- To identify, explore the complex problem-solving strategies and approaches
- To analyze the concepts of basic concepts of neural networks and learning process
- To explore and analyze the methodology used in machine learning

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Apply the basic concepts of artificial intelligence and the use of agents into the real-world scenario

**CO-2:** Design and formulate complex problem solutions with the use of various searching techniques

**CO-3:** Correlate the algorithmic approach of machine learning algorithms for a given case study

**CO-4:** Analyse the phenomenon of neural networks and apply basic learning laws

**UNIT – I:**

**Introduction to AI:** Foundations of AI – History of AI - Applications of AI, Intelligent Agents – Agents and Environments – Nature of Environments – Structure of Agents – Problem solving Agents – Problem formulation – Example Problems.

**UNIT – II:**

**Searching Techniques:** Uninformed Search Strategies – Breadth first search – Depth first search – Depth limited search - Bidirectional search – comparison – Search with partial information - Heuristic search – Greedy best first search – A\* search – Memory bounded heuristic search - Heuristic functions - Local search- Hill climbing – Simulated annealing search - Local beam search, Genetic algorithms.

**UNIT – III:**

**Constraint Satisfaction Problems:** Backtracking search for CSP's - local search for constraint satisfaction problem. *Adversarial search* – Games - Minimax algorithm, Alpha beta pruning, cutting-off search.

**UNIT – IV:**

**Knowledge Representation and Reasoning:** Propositional Logic, Rules of Inference, First Order Logic (FOL) Syntax, Semantics, Entailment.

**UNIT – V:**

**Classical Planning:** Definition of Classical Planning, Algorithms for Planning with State Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches.

**UNIT – VI:**

**Planning and Acting in the Real World:** Time, Schedules, and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multi agent Planning.

**TEXT BOOKS:**

1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, 3<sup>rd</sup> Edition, Prentice Hall, 2010
2. Machine Learning, Tom M. Mitchell, McGraw-Hill Publications
3. Neural Networks A Comprehensive Foundation, Simon Haykin, 2<sup>nd</sup> Edition, Pearson Education, 2004

**REFERENCES:**

1. Artificial Intelligence, Elaine Rich & Kevin Knight, 2<sup>nd</sup> Edition, TMH
2. Artificial Intelligence-A New Synthesis, Nils J. Nilsson, Elsevier
3. Artificial Neural Networks, Yegnanarayana B., PHI

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(A19OE1CS02) MACHINE LEARNING TECHNIQUES

**COURSE PRE-REQUISITES:** Mathematics for Artificial Intelligence, Fundamentals of Artificial Intelligence

**COURSE OBJECTIVES:**

- To understand applications in computational learning theory
- To analyse the pattern comparison techniques

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Familiarize the basic concepts, notations, mathematical understanding required for machine learning applications

**CO-2:** Understand various kinds of models and algorithms used for machine learning

**CO-3:** Apply the suitable machine learning techniques to solve real world applications

**CO-4:** Demonstrate given technique for various data analysis applications

**UNIT – I:**

**Introduction to Machine Learning:** Perspectives and issues in machine learning, Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation.

**UNIT – II:**

**Supervised Learning:** Classification, decision boundaries; nearest neighbor methods, Decision Tree Learning – Introduction, decision tree representation, appropriate problems for decision tree learning, Linear classifiers Bayes' Rule and Naive Bayes' classification

**Regression:** Regression types, gradient descent; features of Over fitting and complexity; training, validation, test data, Logistic regression and applications.

**UNIT -III:**

**Unsupervised Learning:** Clustering, k-means, hierarchical, partition-based clustering, overlapping clustering, Support vector machines, Support vector regression.

**UNIT -IV:**

**Reinforcement Learning:** Introduction to Reinforcement learning, the learning task, rewards and actions, temporal difference learning, generalizing from examples, relationship to dynamic programming.

**UNIT- V:**

**Instance-Based Learning:** Introduction, k-nearest neighbour algorithm, locally weighted regression, radial basis functions, case-based reasoning, remarks on lazy and eager learning.

**UNIT – VI:**

**Neural Networks:** Introduction to neural networks, neural network representation, appropriate problems for neural network learning, perceptions, multilayer networks and Convolution neural networks.

**TEXT BOOKS:**

1. Machine Learning, Tom M. Mitchell, McGraw-Hill
2. Neural Networks and Learning Machines, S. Haykin, Pearson, 2008

**REFERENCES:**

1. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis
2. Machine Learning: The Art and Science of Algorithms that make Sense of Data, Peter Flash, Cambridge, University Press
3. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, MIT Press, 2012

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**(A19OE1CS03) DEEP LEARNING**

**COURSE PRE-REQUISITES:** Mathematics for Artificial Intelligence, Fundamentals of Artificial Intelligence, Machine Learning Techniques

**COURSE OBJECTIVES:**

- To introduce the foundations of deep learning
- To acquire the knowledge on Deep Learning Concepts

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Identify and select appropriate learning network models required for real world problems

**CO-2:** Design an efficient model with various deep learning techniques

**CO-3:** Implement deep learning algorithms and solve real-world problems

**CO-4:** Apply optimization strategies necessary for problem solving required for large scale applications

**UNIT – I:**

**Introduction to Deep Learning:** History of Deep Learning, Deep Learning Success Stories, Biological Neuron, Idea of computational units, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm and Convergence.

**UNIT – II:**

**Feedforward Networks:** Multilayer Perceptron, Gradient Descent, Back-propagation, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization, Counter Propagation Networks, Adaptive Resonance Theory Networks.

**UNIT – III:**

**Regularization for Deep Learning:** Parameter norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised learning, Multi-task learning, Early Stopping, Parameter Typing and Parameter Sharing, Sparse Representations, Bagging and other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, tangent Prop and Manifold, Tangent Classifier.

**UNIT – IV:**

**Optimization for Training Deep Models:** Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-Order Methods, Optimization Strategies and Meta-Algorithm.

**UNIT – V:**

**Convolutional Neural Networks:** LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Markov Networks, Object Detection, RCNN, Fast RCNN, Faster RCNN, YOLO

**UNIT – VI:**

**Auto-Encoders:** Regularization in auto-encoders, De-noising auto-encoders, Sparse auto-encoders, Contractive auto-encoders, Structured probabilistic models of deep learning.

**TEXT BOOKS:**

1. Deep Learning: An MIT Press Book, Ian Goodfellow and Yoshua Bengio and Aaron Courville
2. Neural Networks and Learning Machines, Simon Haykin, 3<sup>rd</sup> Edition, Pearson Prentice Hall

**REFERENCES:**

1. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
2. Pattern Recognition and Machine Learning, Christopher Bishop, 2007



# **BLOCKCHAIN TECHNOLOGIES**

## **BLOCKCHAIN TECHNOLOGIES**

The blockchain is one of the fastest growing skills in the IT sector today. This track will help the students to gain knowledge in blockchain technology, it has taken quite a turn in the industry given its popularity in providing safe and secured online transactions. Most individuals and organizations have started adopting blockchain because of the many benefits it offers to the industry today. It is used in many industry applications such as banking sector, voting, health care, real estate, the legal industry and government.

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(A19OE1CS04) FUNDAMENTALS OF COMPUTER NETWORKS

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To introduce the fundamental various types of computer networks
- To demonstrate the TCP/IP and OSI models with merits and demerits
- To explore the various layers of OSI model
- To introduce UDP and TCP models
- To have the concept of different routing techniques for data communications

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand and explore the basics of Computer Networks and Various Protocols and in a position to understand the World Wide Web concepts

**CO-2:** Position to administrate a network and flow of information

**CO-3:** Understand easily the concepts of network security, Mobile and ad-hoc networks

**UNIT – I:**

**Introduction to Networks:** Internet, Protocols and Standards, The OSI Model, Layers in OSI Model, TCP/IP Suite, Addressing.

**Physical Layer:** Multiplexing, Transmission Media, Circuit Switched Networks, Datagram Networks, and Virtual Circuit Networks.

**UNIT – II:**

**Data Link Layer:** Introduction, Checksum, Framing, Flow and Error Control, Noiseless Channels, Noisy Channels, Random Access Controlled Access, Channelization, IEEE Standards, Ethernet, Giga-Bit Ethernet, Wireless LANs, SONET-SDH, Frame Relay and ATM.

**UNIT – III:**

**Network Layer:** Logical Addressing, Internetworking, Tunneling, Address Mapping, ICMP, IGMP, Forwarding, Routing-Flooding, Bellman& Ford, Disjkstra's routing protocols, RIP, OSPF, BGP and Multicast Routing Protocols. Connecting Devices- Passive Hubs, Repeaters, Active Hubs, Bridges, Routers.

**UNIT – IV:**

**Transport Layer:** Process to Process Delivery, UDP, TCP and SCTP Protocols, Congestion, Congestion Control, Quality of Service.

**UNIT – V:**

**Application Layer:** Domain Name Space, DNS in Internet, Electronic Mail, File Transfer Protocol, WWW, HTTP, SNMP, Multi-Media.

**UNIT – VI:**

**Network Security:** Security services, mechanisms and attacks, IPSec, SSL, VPN, Firewall. Bluetooth, Zigbee, IPv4, IPv6.

**TEXT BOOKS:**

1. Data Communications and Networking, Behrouz A. Forouzan, 4<sup>th</sup> Edition, McGraw-Hill Education, 2006
2. Computer Networks, Andrew S. Tanenbaum, 4<sup>th</sup> Edition, Pearson Education
3. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 3<sup>rd</sup> Edition, Pearson Education

**REFERENCES:**

1. Data Communications and Networks, William Stallings
2. Data Communication and Networks, Bhusan Trivedi, Oxford University Press, 2016
3. An Engineering Approach to Computer Networks, S. Keshav, 2<sup>nd</sup> Edition, Pearson Education
4. Understanding Communications and Networks, 3<sup>rd</sup> Edition, W. A. Shay, Cengage Learning

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(A19OE1CS08) RELATIONAL DATABASE MANAGEMENT SYSTEMS

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To understand the basic concepts and the applications of database systems
- To master the basics of SQL and construct queries using SQL
- To understand the relational database design principles
- To become familiar with the basic issues of transaction processing and concurrency control
- To become familiar with database storage structures and access techniques

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Demonstrate the basic elements of a relational database management system

**CO-2:** Identify the data models for relevant problems

**CO-3:** Design entity relationship model and convert entity relationship diagrams into RDBMS and formulate SQL queries on the data

**CO-4:** Apply normalization for the development of application software

**UNIT – I:**

**Introduction:** Database System Applications, Purpose of Database Systems, View of Data, Database Languages – DDL, DML, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Data Mining and Information Retrieval, Specialty Databases, Database Users and Administrators, History of Database Systems.

**Introduction to Database Design:** Database Design and ER diagrams, Entities, Attributes and Entity sets, Relationships and Relationship sets, Additional features of ER Model, Conceptual Design with the ER Model, Conceptual Design for Large enterprises.

**Relational Model:** Introduction to the Relational Model, Integrity Constraints over Relations, Enforcing Integrity constraints, Querying relational data, Logical data base Design: ER to Relational, Introduction to Views, Destroying /Altering Tables and Views.

**UNIT – II:**

**Relational Algebra and Calculus:** Preliminaries, Relational Algebra, Relational calculus – Tuple relational Calculus, Domain relational calculus, Expressive Power of Algebra and calculus.

**SQL:** Queries, Constraints, Triggers: Form of Basic SQL Query, UNION, INTERSECT, and EXCEPT, Nested Queries, Aggregate Operators, NULL values Complex Integrity Constraints in SQL, Triggers and Active Data bases, Designing Active Databases.

**UNIT – III:**

**Schema Refinement and Normal Forms:** Introduction to Schema Refinement, Functional Dependencies - Reasoning about FDs, Normal Forms, Properties of Decompositions, Normalization, Schema Refinement in Database Design, Other Kinds of Dependencies.

**UNIT – IV:**

**Transaction Management:** Transactions, Transaction Concept, A Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Transaction Isolation and Atomicity Transaction Isolation Levels, Implementation of Isolation Levels.

**UNIT – V:**

**Concurrency Control:** Lock-Based Protocols, Multiple Granularity, Timestamp-Based Protocols, Validation-Based Protocols, Multiversion Schemes.

Recovery System-Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management, Failure with loss of nonvolatile storage, Early Lock Release and Logical Undo Operations, Remote Backup systems.

**UNIT – VI:**

**Storage and Indexing:** Overview of Storage and Indexing: Data on External Storage, File Organization and Indexing, Index Data Structures, Comparison of File Organizations.

**Tree-Structured Indexing:** Intuition for tree Indexes, Indexed Sequential Access Method (ISAM), B+ Trees: A Dynamic Index Structure, Search, Insert, Delete.

Hash- Based Indexing: Static Hashing, Extendible hashing, Linear Hashing, Extendible vs. Linear Hashing.

**TEXT BOOKS:**

1. Database Management Systems, Raghu Ramakrishnan, Johannes Gehrke, 3<sup>rd</sup> Edition, McGraw-Hill
2. Database System Concepts, A. Silberschatz, Henry. F. Korth, S. Sudarshan, 6<sup>th</sup> Edition, McGraw-Hill
3. Database Systems, R. Elmasri, Shamkant B. Navathe, 6<sup>th</sup> Edition, Pearson Education

**REFERENCES:**

1. Database System Concepts, Peter Rob & Carlos Coronel, Cengage Learning
2. Introduction to Database Management, M. L. Gillenson and others, Wiley
3. Database Development and Management, Lee Chao, Auerbach Publications, Taylor & Francis Group

4. Introduction to Database Systems, C. J. Date, Pearson Education

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(A19OE1CS05) DISTRIBUTED DATA BASES

**COURSE PRE-REQUISITES:** Fundamentals of Computer Networks

**COURSE OBJECTIVES:**

- To introducing distributed databases and exploring several algorithms for processing queries and be able to use them
- To describe the methods to translate complex conceptual data models into logical and Physical database designs
- To demonstrating query optimization and its algorithms
- To enumerating the concepts behind distributed transaction processing

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Analyze issues related to distributed database design

**CO-2:** Apply Partitioning techniques to databases

**CO-3:** Design and develop query processing strategies

**CO-4:** Describe transaction processing and concurrency control in distributed databases

**UNIT – I:**

**Introduction:** Features of Distributed versus Centralized Databases,

**Levels of Distribution Transparency:** Reference Architecture for Distributed Databases, Types of Data Fragmentation, Distribution transparency for Read – only Applications, Distribution transparency for update Applications, Distributed database Access primitives, Integrity Constraints in Distributed Databases.

**UNIT – II:**

**Distributed Database Design:** A framework, the design of database fragmentation, the allocation of fragments.

**Translation of Global Queries to Fragment Queries:** Equivalence Transformations for Queries, Transforming Global Queries into Fragment Queries, Distributed Grouping and Aggregate Function Evaluation, Parametric Queries.

**UNIT – III:**

**Optimization of Access Strategies:** A Framework for Query Optimization, Join Queries, General Queries.

**UNIT – IV:**

**The Management of Distributed Transactions:** A Framework for Transaction Management, Supporting Atomicity of Distributed Transactions, Concurrency Control for Distributed Transactions, Architectural aspects of Distributed Transactions.



**UNIT – V:**

**Concurrency Control:** Foundation of Distributed Concurrency Control, Distributed Deadlocks, Concurrency Control based on Timestamps, Optimistic Methods for Distributed Concurrency Control.

**UNIT – VI:**

**Reliability:** Basic Concepts, Nonblocking Commitment Protocols, Reliability and concurrency Control, Determining a Consistent View of the Network, Detection and Resolution of Inconsistency, Checkpoints and Cold Restart.

**TEXT BOOKS:**

1. Principles of Distributed Database Systems, M. Tamer OZSU and Patuck Valduriez, Pearson Education Asia, 2001
2. Distributed Databases, Stefano Ceri and Willipse Pelagatti, McGraw-Hill

**REFERENCES:**

1. Database System Concepts, Henry F. Korth, A. Silberchatz and Sudershan, MGH
2. Database Management Systems, Raghuramakrishnan and Johhanes Gehrke, MGH

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(A19OE1CS06) CRYPTOGRAPHY AND NETWORK SECURITY

**COURSE PRE-REQUISITES:** Fundamentals of Computer Networks, Distributed Data Bases

**COURSE OBJECTIVES:**

- To outline security concepts, threats, attacks, services and mechanisms
- To describe various cryptosystems- symmetric key cryptography, public key cryptography
- To apply authentication services and Secure hash functions
- To discuss the concepts of IP Security, web security, viruses and firewalls

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Analyze the security attacks, services, goals and mechanism of security

**CO-2:** Develop a security model using conventional approach to prevent the attacks

**CO-3:** Apply public key cryptography principles, examine authenticity and integrity of the messages in the communication

**CO-4:** Build a model for IP security, firewall and test the security issues

**UNIT – I:**

**Security Attacks:** Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards and RFCs, Buffer overflow & format string vulnerabilities, TCP session hijacking, ARP attacks, route table modification, UDP hijacking, and man-in-the-middle attacks.

**UNIT – II:**

**Conventional Encryption:** Classical Encryption techniques, Fiestel Cipher Structure, Data Encryption Standard, Block Cipher Design Principles and Modes of Operation, Triple DES, RC-4, Evaluation criteria for AES, AES Cipher, Placement of Encryption Function, Traffic Confidentiality.

**UNIT – III:**

**Public Key Cryptography and Authentication:** Confidentiality using Symmetric Encryption – Principles of Public key Cryptosystems, RSA algorithm, Key Management, Diffie-Hellman key Exchange, Elliptic Curve Cryptography. Authentication requirements, Authentication functions, Message Authentication Codes

**UNIT – IV:**

**Hash Functions:** Hash Functions, Security of Hash Functions and MACs, MD5 message Digest algorithm, Secure Hash Algorithm, HMAC, Digital Signatures, Authentication Protocols, Digital Signature Standard, Authentication Applications: Kerberos, X.509 Authentication Service

**UNIT – V:**

**Network Security:** Email Security and Web Security

Electronic Mail Security – PGP/ SMIME, IP security- Architecture, Authentication Header, Encapsulating Security Payload, Key Management, Web Security- Secure Socket Layer, Transport Layer Security and Secure Electronic Transaction

**UNIT – VI:**

**System Level Security:** Intrusion detection – password management – Viruses and related Threats – Virus Counter measures – Firewall Design Principles – Trusted Systems.

**TEXT BOOKS:**

1. Cryptography and Network Security – Principles and Practices, William Stallings, 4<sup>th</sup> Edition, Prentice Hall of India, 2005
2. Hack Proofing Your Network, Ryan Russell, Dan Kaminsky, Rain Forest, Puppy, Joe Grand, David Ahmad, Hal Flynn Ido Dubrawsky, Steve W. Manzuik and Ryan Permech, Wiley Dreamtech

**REFERENCES:**

1. Network Security Essentials: Applications and Standards, William Stallings, Prentice Hall, 1999
2. Security in Computing, Charles B. Pfleeger, Shari Lawrence Pfleeger, 3<sup>rd</sup> Edition, Pearson Education, 2003

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(A19OE1CS07) BLOCKCHAIN TECHNOLOGY

**COURSE PRE-REQUISITES:** Fundamentals of Computer Networks, Distributed Data Bases, Cryptography and Network Security

**COURSE OBJECTIVES:**

- To get the terminologies and overview of blockchain technologies
- To study the concepts and foundation of blockchain technology
- To understand security mechanism and consensus in blockchain
- To design use cases and architecture blockchain technology

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Gain a clear understanding of the concepts that underlie digital distributed ledger

**CO-2:** Understand key mechanisms like Decentralization, Transparency and trust, Immutability, High availability, Highly secure and different types of Blockchain

**CO-3:** Apply the concept of Hash Function and Related Hash Algorithm

**CO-4:** Design and implement applications using Blockchain Technology

**UNIT – I:**

**Introduction to Blockchain Part I:** Introduction to Centralized, Decentralized and Distributed system, History of Blockchain, Various technical definitions of Blockchain.

**Introduction to Blockchain Technology Part II:** Generic elements of a blockchain: Block, Transaction, Peer-to-peer network, Node, Smart contract, Why It's Called "Blockchain", Characteristics of Blockchain Technology, Advantages of blockchain technology.

**UNIT – II:**

**Concept of Blockchain Technology Part I:** Cryptography, Hashing, Nonce, Distributed database, Consensus, Smart Contract, Component of block, Structure of Block chain, Technical Characteristics of the Blockchain.

**Concept of Blockchain Technology Part II:** Applications of blockchain technology, Tiers of blockchain technology Blockchain 0, Blockchain 1, Blockchain 2, Blockchain 3, Generation of Blockchain X.

**UNIT – III:**

**Technical Foundations Part I:** Cryptography, Confidentiality, Integrity, Authentication, Cryptographic primitives, Public and private keys, RSA, Discrete logarithm problem, Hash Function: Message Digest (MD), Secure Hash Algorithms (SHAs), Design of Secure Hash Algorithms (SHA), SHA-256, Design of SHA3, Elliptic Curve Digital signature algorithm.

**Technical Foundations Part II:** Consensus algorithm: Proof of work (PoW), Proof-of-Stake (PoS), Byzantine Fault Tolerance (BFT)

**UNIT – IV:**

**Types of Blockchain:** Public blockchains, Private blockchains, Semi-private blockchains, Side chains, Permissioned ledger, Distributed ledger, Shared ledger, Fully private and proprietary blockchains, Tokenized blockchains, Tokenless blockchains, CAP theorem and blockchain

**UNIT – V:**

Financial markets and trading, Trading, Exchanges, Trade life cycle, Order anticipators, Market manipulation.

**Crypto Currency:** Bitcoin, Bitcoin definition, Keys and addresses, Public keys in Bitcoin, Private keys in Bitcoin, Bitcoin currency units

**UNIT – VI:**

**Implementation Platforms:** Hyperledger as a protocol, Reference architecture, Hyperledger Fabric, Transaction Flow, Hyperledger Fabric Details, Fabric Membership, Fabric Membership

**TEXT BOOKS:**

1. Mastering Blockchain, Imaran Bashir, Second Edition, Packt
2. Blockchain Basic, Daniel Drescher, A Press

**REFERENCES:**

1. Blockchain For Dummies®, IBM Limited Edition, John Wiley & Sons

# ROBOTICS

## ROBOTICS

Robotics is a field of study that involves the design, construction and operation of robots. This field overlaps with electronics, computer science, mechatronics and artificial intelligence. Robotic companies are booming all over the world and are seeking engineers with skills for implementing **Next -Level Automation**. This Open Elective Track for Robotics consists of four courses and is intended for making students industry ready in the field of robotics.

The First course in this track” **Fundamentals of Robotics**” introduces various physical aspects of building a robot, exploring topics like how a robot perceives its environment using Sensors and how it interacts with its environment through various Actuators & Grippers. This course also inspects a variety of robot applications in different domains. Second Course in this track” **Kinematics & Dynamics of robots**” delves a level deeper discussing analysis and control of robots. It establishes strong mathematical foundation for describing and controlling robot movement. In this course students will learn in detail about Forward Kinematics, Inverse Kinematics, Workspace Analysis and Trajectory planning for robots.

Third Course in the Robotics track “**Drives and Control System for Robots**” explores in detail various Drive Mechanisms used in robotics such as Hydraulic, Pneumatic & Electric drives. After completing this course students will be able to analyze operational aspects of a drive system for a given robotic application. Fourth Course in the track “**Robot Programming and Intelligent Control System**” expands on Robot Programming, discussing various aspects of Robot Programming Languages and their functions. This course also dives deep into advanced topics like Artificial Intelligence, Neural Networks and Fuzzy control for robots.

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(A19OE1EI01) FUNDAMENTALS OF ROBOTICS

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To understand the basic components of a Robot
- To learn different types of Robot sensors and actuators used in Robotics
- To identify different types of Robot grippers and their applications
- To acquire basic Knowledge on Robot kinematics
- To expose to various application fields of Robotics

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Gain knowledge about basic concepts of robots

**CO-2:** Appreciate the usage of different sensors and actuators in Robotics

**CO-3:** Select appropriate Gripping mechanism for a particular application

**CO-4:** Analyze the direct and the inverse kinematic problems

**CO-5:** Appreciate robot design deference's for various applications

**UNIT – I:**

**Basic Concepts:** An overview of Robotics, classification of Robots, Robot Components, Robot degrees of freedom, Robot Joints, Robot Coordinates, Robot reference frames, Programming modes, Robot Characteristics.

**UNIT – II:**

**Sensors:** Sensor characteristics, Position sensors, Velocity sensors, Acceleration sensors, Force and Pressure sensors, Torque sensors, Microswitches, Light and infrared sensors, Touch and tactile sensors, Proximity sensors, Range finders.

**UNIT – III:**

**Actuators:** Characteristics of actuating system, Comparison of actuating systems, Hydraulic actuators, Pneumatic devices, Electric motors, Magneto-strictive actuators, Shape-Memory Metals, Electro-active Polymer Actuators.

**UNIT – IV:**

**Grippers:** Classification of Grippers, Drive system for Grippers, Mechanical Grippers, Magnetic Grippers, Vacuum Grippers, Adhesive Grippers, Hooks and Scoops, Gripper Force analysis and design, Active and Passive Grippers.



**UNIT – V:**

**Kinematics:** Robots as Mechanisms, Matrix Representation, Homogeneous Transformation Matrices, Representation of Transformations, Inverse of Transformation Matrices, Forward and Inverse Kinematics with Equations.

**UNIT – VI:**

**Applications:** Industrial applications, material handling, processing, assembly application, inspection application, application planning, justification of robots, non-industrial applications, Robot safety.

**TEXT BOOKS:**

1. Introduction to Robotics: Analysis, Control, Applications, Saeed B. Niku, 2<sup>nd</sup> Edition, Wiley
2. Robotics Technology and Flexible Automation, Deb S. R., John Wiley
3. Robotics and Control, R. K. Mittal, I. J. Nagrath, McGraw-Hill Education

**REFERENCES:**

1. Industrial Robotics, Technology programming and Applications, Mikell P. Groover, Nicholas G. Odrey, Mitchel Weiss, Roger N. Nagel, Ashish Dutta, McGraw-Hill, 2012
2. Robotics-Control, Sensing, Vision and Intelligence, K. S. Fu, R. C. Gonzalez, C. S. G. Lee, McGraw-Hill International Edition
3. Robotic Engineering–An Integrated Approach, Klaffer R. D., Chimielewski T. A., Negin M., Prentice Hall of India, 2009

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(A19OE1EI02) KINEMATICS AND DYNAMICS OF ROBOTS

**COURSE PRE-REQUISITES:** Fundamentals of Robotics

**COURSE OBJECTIVES:**

- To understand the basics of robot coordinate frames and their representation
- To obtain knowledge about direct kinematics and inverse kinematics for a robot manipulator
- To examine techniques for planning robot motion in a workspace
- To understand various methods for developing dynamic models for manipulator
- To learn control techniques applied to robot manipulators

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Mathematically represent a Robot system

**CO-2:** Calculate robot hand position and orientation for specific joint angles

**CO-3:** Calculate joint angles to achieve a particular hand position

**CO-4:** Plan trajectories for robot tool to do meaningful tasks

**CO-5:** Analyze different controlling techniques used for robot manipulators

**UNIT – I:**

**Introduction:** Introduction, position and orientation of objects, objects coordinate frame Rotation matrix, Euler angles Roll, pitch and yaw angles coordinate Transformations, Joint variables and position of end effector, Dot and cross products.

**UNIT – II:**

**Direct Kinematics:** Coordinate frames, Rotations, Homogeneous coordinates, Link coordinates D-H Representation, The ARM equation. Direct kinematic analysis for Four axis SCARA Robot and three, five and six axis Articulated Robots.

**UNIT – III:**

**Inverse Kinematics:** The inverse kinematics problem, General properties of solutions. Tool configuration, Inverse kinematics of four axis SCARA robot and three and five axis Articulated robot.

**UNIT – IV:**

**Workspace Analysis and Trajectory Planning:** Workspace Analysis, work envelope of a Four axis SCARA robot and five axis articulated robot workspace fixtures, the pick and place operations, Joint space technique - continuous path motion, Interpolated motion, straight line motion and Cartesian space technique in trajectory planning.

**UNIT – V:**

**Manipulator Dynamics:** Introduction, Lagrange's equation kinetic and potential energy. Link inertia Tensor, link Jacobian Manipulator inertia tensor. Gravity, Generalized forces, Lagrange-Euler Dynamic model, Dynamic model of a Two-axis planar robot, Newton Euler formulation, Lagrange - Euler formulation, problems.

**UNIT – VI:**

**Robot Control:** The Control Problem, State Equations: one axis robot; three axis SCARA robot, Constant solutions, Linear Feedback Systems, Single Axis PID Control, PD- Gravity Control.

**TEXT BOOKS:**

1. Fundamentals of Robotics: Analysis & Control, Robert J. Schilling, Prentice Hall of India
2. Robotics and Control, R. K. Mittal, I. J. Nagrath, McGraw-Hill Education

**REFERENCES:**

1. Robotic Engineering–An Integrated Approach, Klaffer R. D., Chimielewski T. A., Negin M., Prentice Hall of India, 2009
2. Industrial Robotics, Technology Programming and Applications, Mikell P. Groover & Nicholas G. Odrey, Mitchel Weiss, Roger N. Nagel, Ashish Dutta, Tata McGraw-Hill Education, 2012
3. Robotics-Control, Sensing, Vision and Intelligence, K. S. Fu, R. C. Gonzalez, C. S. G. Lee, McGraw-Hill International

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(A19OE1EI03) DRIVES AND CONTROL SYSTEM FOR ROBOTICS

**COURSE PRE-REQUISITES:** Fundamentals of Robotics, Kinematics and Dynamics of Robotics

**COURSE OBJECTIVES:**

- To get acquainted with different robot drive mechanisms
- To understand in detail, working of hydraulic and pneumatic drives used in robotics
- To learn working principles of various electric drive systems for robotics
- To acquire basic Knowledge on servo systems for robot control

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Categorize various drive systems for robot movement

**CO-2:** Select appropriate drive system for a particular application

**CO-3:** Inspect different electric drives and their applications in robotics

**CO-4:** Analyze accurate positioning of robot end effector by servo control

**UNIT – I:**

**Introduction:** Objectives, motivation, open loop control, closed loop control with velocity and position feedback, Types of drive systems. Functions of drive system.

**UNIT – II:**

**Robot Drive Mechanism:** Lead Screws, Ball Screws, Chain & linkage drives, Belt drives, Gear drives, Precision gear boxes, Harmonic drives, Cyclo speed reducers.

**UNIT – III:**

**Hydraulic Drives:** Introduction, Requirements, Hydraulic piston and transfer valve, hydraulic circuit incorporating control amplifier, hydraulic fluid considerations, hydraulic actuators Rotary and linear actuators. Hydraulic components in robots.

**UNIT – IV:**

**Pneumatic Drives:** Introduction, Advantages, pistons-Linear Pistons, Rotary pistons, Motors-Flapper motor, Geared motor, Components used in pneumatic control. Pneumatic proportional controller, pneumatically controlled prismatic joint.

**UNIT – V:**

**Electric Drives:** Introduction, Types, DC electric motor, AC electric motor, stepper motors, half step mode operation, micro step mode. Types of stepper motors, Direct drive actuator.

**UNIT – VI:**

**Servo Mechanism for Robot:** Mathematical modeling of robot servos, error responses and steady state errors in robot servos, feedback and feed forward compensations, hydraulic position servo, computer-controlled servo system for robot applications, selection of robot drive systems.

**TEXT BOOKS:**

1. Engineering Foundation of Robotics, Francis N-Nagy Andras Siegler, Prentice Hall
2. Robotics Engineering - An Integrated Approach, Richard D. Klaffer, Thomas A., Chri Elewski, Michael Negin, PHI Learning, 2009

**REFERENCES:**

1. Industrial Robotics, Technology Programming and Applications, Mikell P. Groover & Nicholas G. Odrey, Mitchel Weiss, Roger N. Nagel, Ashish Dutta, Tata McGraw-Hill Education, 2012
2. Industrial Robotics, Bernard Hodges, 2<sup>nd</sup> Edition, Jaico Publishing House, 1993
3. Fundamentals of Robotics Analysis and Control, Robert J. Schilling, PHI Learning, 2009
4. Foundations of Robotics Analysis and Control, Tsuneo Yohikwa, MIT Press, 2003
5. Introduction to Robotics Mechanics and Control, John J. Craig, 3<sup>rd</sup> Edition, Pearson, 2008

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(A19OE1EI04) ROBOT PROGRAMMING AND INTELLIGENT CONTROL SYSTEM

**COURSE PRE-REQUISITES:** Fundamentals of Robotics, Kinematics and Dynamics of Robotics, Drives and Control Systems for Robotics

**COURSE OBJECTIVES:**

- To understand the fundamentals of robot programming
- To learn robot textual languages that are in common use
- To expose to artificial intelligence in robotics
- To acquire basic Knowledge on neural networks in robotics
- To acquire basic Knowledge on fuzzy logic in robotics

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Gain knowledge about different methods of robot programming

**CO-2:** Examine various robot language elements and their functions

**CO-3:** Analyze different AI techniques employed in robotics

**CO-4:** Design basic neuro-controller for robot motion control

**CO-5:** Apply fuzzy logic to robot control systems

**UNIT – I:**

**Robot Programming:** Methods of robot programming, leadthrough programming methods, robot program as a path in space - defining position in space, speed control, motion interpolation, WAIT, SIGNAL, DELAY commands, Branching.

**UNIT – II:**

**Robot Languages:** Textual robot language, generations of robot languages, robot language structure, operating systems, Robot language Elements and functions, constraints and variables, aggregates and location variables.

**UNIT – III:**

**Basic Commands and Operations:** Motion commands- move and related statements, speed control, points in workspace, paths and frames. End effector and sensor commands- end effector operation, sensor operation, REACT statement. Computations and operation. Program control and subroutines. Communications and data processing. Monitor mode commands.

**UNIT – IV:**

**AI for Robotics:** Introduction to Artificial Intelligence, goals of AI research, AI techniques- knowledge representation, problem representation, search techniques. LISP programming. AI and Robotics. LISP in the factory. Robotic Paradigms.

**UNIT – V:**

**Neural Network Approach in Robotics:** Introduction, Connectionist Models, Learning Principles and Learning Rules: Supervised, unsupervised, reinforcement learning. Sensor based robot learning, Neural Network in Robotics: Control of robot hands by neural network, neural set approach to robot motion coordination, robotic motor control using reinforcement learning optimization.

**UNIT – VI:**

**Fuzzy Logic Approach in Robotics:** Introduction, Fuzzy sets, Operation of Fuzzy sets, Fuzzy relations, Fuzzy rule formation, Control rules, Fuzzy algorithm in robotics, Robot obstacle avoidance using fuzzy logic, Fuzzy logic for robot path tracking and behavior coordination, fuzzy control system in mobile robots, fuzzy controller design for robot systems, Case study of fuzzy logic in robotics.

**TEXT BOOKS:**

1. Industrial Robotics Technology, Programming and Applications, Mikell P. Groover, McGraw-Hill, 2012
2. Robotics Technology and Flexible Automation, Deb S. R., Tata McGraw-Hill

**REFERENCES:**

1. Design and Control of Intelligent Robotic Systems, (Studies in Computational Intelligence 177) M. Begum, F. Karray (auth.), Dikai Liu, Lingfeng Wang, Kay Chen Tan (eds.), Springer
2. Neural Networks in Robotics, Edited by George Bekey, Kenneth Y. Goldberg, Springer, 2012
3. Neural Networks, Fuzzy Logic, Genetic Algorithm - Synthesis and Applications, Rajasekharan and Rai, PHI Publications
4. Introduction to Neural Networks using MATLAB 6.0, S. N. Sivanandam, S. Sumathi, S. N. Deepa, TMH, 2006

# **CYBER SECURITY**



## CYBER SECURITY

**Cybersecurity is important** because it incorporates everything that relates to protecting our sensitive data, personally identifiable information (PII), protected health information (PHI), personal information, intellectual property, data, and governmental and **industry** information systems from stealing and destruction endeavoured. The cyber security track helps students to learn about how to Defend networks and data from unapproved access.

Enhanced information security and business endurance supervision.

Upgraded stakeholder confidence in your information security preparations.

Developed company authorizations with the correct security controls in place.

### **Some of the more common career paths in the cyber security path are**

- Chief Information Security Officer. ...
- Forensic Computer Analyst. ...
- Information Security Analyst. ...
- Penetration Tester. ...
- Security Architect. ...
- IT Security Engineer. ...
- Security Systems Administrator. ...
- IT Security Consultant.

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(A19OE1CS04) FUNDAMENTALS OF COMPUTER NETWORKS

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To introduce the fundamental various types of computer networks
- To demonstrate the TCP/IP and OSI models with merits and demerits
- To explore the various layers of OSI model
- To introduce UDP and TCP models
- To have the concept of different routing techniques for data communications

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand and explore the basics of Computer Networks and Various Protocols and in a position to understand the World Wide Web concepts

**CO-2:** Administrate a network and flow of information

**CO-3:** Understand easily the concepts of network security, Mobile and ad-hoc networks

**UNIT – I:**

**Introduction to Networks:** Internet, Protocols and Standards, The OSI Model, Layers in OSI Model, TCP/IP Suite, Addressing.

**Physical Layer:** Multiplexing, Transmission Media, Circuit Switched Networks, Datagram Networks, and Virtual Circuit Networks.

**UNIT – II:**

**Data Link Layer:** Introduction, Checksum, Framing, Flow and Error Control, Noiseless Channels, Noisy Channels, Random Access Controlled Access, Channelization, IEEE Standards, Ethernet, Giga-Bit Ethernet, Wireless LANs, SONET-SDH, Frame Relay and ATM.

**UNIT – III:**

**Network Layer:** Logical Addressing, Internetworking, Tunneling, Address Mapping, ICMP, IGMP, Forwarding, Routing-Flooding, Bellman& Ford, Disjkstra's routing protocols, RIP, OSPF, BGP,- and Multicast Routing Protocols. Connecting Devices- Passive Hubs, Repeaters, Active Hubs, Bridges, Routers.

**UNIT – IV:**

**Transport Layer:** Process to Process Delivery, UDP, TCP and SCTP Protocols, Congestion, Congestion Control, Quality of Service.

**UNIT – V:**

**Application Layer:** Domain Name Space, DNS in Internet, Electronic Mail, File Transfer Protocol, WWW, HTTP, SNMP, Multi-Media.

**UNIT – VI:**

**Network Security:** Security services, mechanisms and attacks, IPSec, SSL, VPN, Firewall, Bluetooth, Zigbee, IPv4, IPv6.

**TEXT BOOKS:**

1. Data Communications and Networking, Behrouz A. Forouzan, 4<sup>th</sup> Edition, McGraw-Hill Education, 2006
2. Computer Networks, Andrew S. Tanenbaum, 4<sup>th</sup> Edition, Pearson Education
3. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 3<sup>rd</sup> Edition, Pearson Education

**REFERENCES:**

1. Data Communications and Networks, William Stallings
2. Data Communication and Networks, Bhusan Trivedi, Oxford University Press, 2016
3. An Engineering Approach to Computer Networks, S. Keshav, 2<sup>nd</sup> Edition, Pearson Education
4. Understanding Communications and Networks, W. A. Shay, 3<sup>rd</sup> Edition, Cengage Learning

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(A19OE1CS08) RELATIONAL DATABASE MANAGEMENT SYSTEMS

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To understand the basic concepts and the applications of database systems
- To master the basics of SQL and construct queries using SQL
- To understand the relational database design principles
- To become familiar with the basic issues of transaction processing and concurrency control
- To become familiar with database storage structures and access techniques

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Demonstrate the basic elements of a relational database management system

**CO-2:** Ability to identify the data models for relevant problems

**CO-3:** Ability to design entity relationship model and convert entity relationship diagrams into RDBMS and formulate SQL queries on the data

**CO-4:** Apply normalization for the development of application software

**UNIT – I:**

**Introduction:** Database System Applications, Purpose of Database Systems, View of Data, Database Languages – DDL, DML, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Data Mining and Information Retrieval, Specialty Databases, Database Users and Administrators, History of Database Systems.

**Introduction to Database Design:** Database Design and ER diagrams, Entities, Attributes and Entity sets, Relationships and Relationship sets, Additional features of ER Model, Conceptual Design with the ER Model, Conceptual Design for Large enterprises.

**Relational Model:** Introduction to the Relational Model, Integrity Constraints over Relations, Enforcing Integrity constraints, Querying relational data, Logical data base Design: ER to Relational, Introduction to Views, Destroying /Altering Tables and Views.

**UNIT – II:**

**Relational Algebra and Calculus:** Preliminaries, Relational Algebra, Relational calculus – Tuple relational Calculus, Domain relational calculus, Expressive Power of Algebra and calculus.

**SQL:** Queries, Constraints, Triggers: Form of Basic SQL Query, UNION, INTERSECT, and EXCEPT, Nested Queries, Aggregate Operators, NULL values Complex Integrity Constraints in SQL, Triggers and Active Data bases, Designing Active Databases.

**UNIT – III:**

**Schema Refinement and Normal Forms:** Introduction to Schema Refinement, Functional Dependencies - Reasoning about FDs, Normal Forms, Properties of Decompositions, Normalization, Schema Refinement in Database Design, Other Kinds of Dependencies.

**UNIT – IV:**

**Transaction Management:** Transactions, Transaction Concept, A Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Transaction Isolation and Atomicity Transaction Isolation Levels, Implementation of Isolation Levels.

**UNIT – V:**

**Concurrency Control:** Lock-Based Protocols, Multiple Granularity, Timestamp-Based Protocols, Validation-Based Protocols, Multiversion Schemes.

Recovery System-Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management, Failure with loss of nonvolatile storage, Early Lock Release and Logical Undo Operations, Remote Backup systems.

**UNIT – VI:**

**Storage and Indexing:** Overview of Storage and Indexing: Data on External Storage, File Organization and Indexing, Index Data Structures, Comparison of File Organizations.

**Tree-Structured Indexing:** Intuition for tree Indexes, Indexed Sequential Access Method (ISAM), B+ Trees: A Dynamic Index Structure, Search, Insert, Delete.

Hash- Based Indexing: Static Hashing, Extendible hashing, Linear Hashing, Extendible vs. Linear Hashing.

**TEXT BOOKS:**

1. Database Management Systems, Raghu Ramakrishnan, Johannes Gehrke, 3<sup>rd</sup> Edition, McGraw-Hill
2. Database System Concepts, A. Silberschatz, Henry F. Korth, S. Sudarshan, 6<sup>th</sup> Edition, McGraw-Hill
3. Database Systems, R. Elmasri, Shamkant B. Navathe, 6<sup>th</sup> Edition, Pearson Education

**REFERENCES:**

1. Database System Concepts, Peter Rob & Carlos Coronel, Cengage Learning
2. Introduction to Database Management, M. L. Gillenson and others, Wiley Student Edition

3. Database Development and Management, Lee Chao, Auerbach Publications, Taylor & Francis Group
4. Introduction to Database Systems, C. J. Date, Pearson Education

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### (A19OE1CS06) CRYPTOGRAPHY AND NETWORK SECURITY

**COURSE PRE-REQUISITES:** Fundamentals of Computer Networks, Distributed Data Bases

#### **COURSE OBJECTIVES:**

- To outline security concepts, threats, attacks, services and mechanisms
- To describe various cryptosystems- symmetric key cryptography, public key cryptography
- To apply authentication services and Secure hash functions
- To discuss the concepts of IP Security, web security, viruses and firewalls

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Analyze the security attacks, services, goals and mechanism of security

**CO-2:** Develop a security model using conventional approach to prevent the attacks

**CO-3:** Apply public key cryptography principles, examine authenticity and integrity of the messages in the communication

**CO-4:** Build a model for IP security, firewall and test the security issues

#### **UNIT – I:**

**Security Attacks:** Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards and RFCs, Buffer overflow & format string vulnerabilities, TCP session hijacking, ARP attacks, route table modification, UDP hijacking, and man-in-the-middle attacks.

#### **UNIT – II:**

**Conventional Encryption:** Classical Encryption techniques, Fiestel Cipher Structure, Data Encryption Standard, Block Cipher Design Principles and Modes of Operation, Triple DES, RC-4, Evaluation criteria for AES, AES Cipher, Placement of Encryption Function, Traffic Confidentiality.

#### **UNIT – III:**

**Public Key Cryptography and Authentication:** Confidentiality using Symmetric Encryption – Principles of Public key Cryptosystems, RSA algorithm, Key Management, Diffie-Hellman key Exchange, Elliptic Curve Cryptography. Authentication requirements, Authentication functions, Message Authentication Codes

**UNIT – IV:**

**Hash Functions:** Hash Functions, Security of Hash Functions and MACs, MD5 message Digest algorithm, Secure Hash Algorithm, HMAC, Digital Signatures, Authentication Protocols, Digital Signature Standard, Authentication Applications: Kerberos, X.509 Authentication Service

**UNIT – V:**

**Network Security:** Email Security and Web Security

Electronic Mail Security – PGP/ SMIME, IP security- Architecture, Authentication Header, Encapsulating Security Payload, Key Management, Web Security- Secure Socket Layer, Transport Layer Security and Secure Electronic Transaction

**UNIT – VI:**

**System Level Security:** Intrusion detection – password management – Viruses and related Threats – Virus Counter measures – Firewall Design Principles – Trusted Systems.

**TEXT BOOKS:**

1. Cryptography and Network Security – Principles and Practices, William Stallings, 4<sup>th</sup> Edition, Prentice Hall of India, 2005
2. Hack Proofing your Network, Ryan Russell, Dan Kaminsky, Rain Forest, Puppy, Joe Grand, David Ahmad, Hal Flynn Ido Dubrawsky, Steve W. Manzuik and Ryan Permech, Wiley Dreamtech

**REFERENCES:**

1. Network Security Essentials: Applications and Standards, William Stallings Prentice Hall, 1999
2. Security in Computing, Charles B. Pfleeger, Shari Lawrence Pfleeger, 3<sup>rd</sup> Edition, Pearson Education, 2003



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(A19OE1IT01) ESSENTIALS OF CYBER SECURITY

**COURSE PRE-REQUISITES:** Fundamentals of Computer Networks, Cryptography and Network Security

**COURSE OBJECTIVES:**

- To identify the key components of cyber security in network
- To describe various security levels and categories, operating system security
- To define authentication issues and network security
- To describe memory management and protection measures

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Categorize cyber-crime and an understand social, political, ethical and psychological dimensions cyber security

**CO-2:** Demonstrate security levels and models with objects and access control

**CO-3:** Analyse tools and methods used in cybercrime

**CO-4:** Understand Organizational Implications and security risks

**UNIT – I:**

**Introduction to Cybercrime:** Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

**UNIT – II:**

**Cyber Offenses: How Criminals Plan Them:** Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

**UNIT – III:**

**Cybercrime: Mobile and Wireless Devices:** Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

**UNIT – IV:**

**Tools and Methods Used in Cybercrime:** Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan

Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

**UNIT – V:**

**Cyber Security:** Organizational Implications

Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications.

**UNIT – VI:**

**Social Media Marketing:** Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

**TEXT BOOKS:**

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley India

**REFERENCES:**

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press
2. Introduction to Cyber Security, Chwan-Hwa (John) Wu, J. David Irwin, CRC Press T&F Group

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(A19OE1IT02) COMPUTER FORENSICS

**COURSE PRE-REQUISITES:** Fundamentals of Computer Networks, Cryptography and Network Security, Essentials of Cyber Security

**COURSE OBJECTIVES:**

- To provide an understanding of computer forensics fundamentals
- To analyze various computer forensics technologies and to provide computer forensics systems
- To identify methods for data recovery
- To apply the methods for preservation of digital evidence

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Define and discuss the concepts of computer forensics

**CO-2:** Explain and apply the concepts of computer investigations

**CO-3:** Select and apply current computer forensics tools

**CO-4:** Identify and apply current practices for processing crime and incident scenes

**UNIT – I:**

**Computer Forensics Fundamentals:** What is Computer Forensics? Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings, Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps taken by Computer Forensics Specialists.

**UNIT – II:**

**Types of Computer Forensics Technology:** Types of Military Computer Forensic Technology, Types of Law Enforcement — Computer Forensic Technology — Types of Business Computer Forensic Technology Computer Forensics Evidence and Capture: Data Recovery Defined — Data Back-up and Recovery — The Role of Back-up in Data Recovery — The Data-Recovery Solution.

**UNIT – III:**

**Evidence Collection and Data Seizure:** Why Collect Evidence? Collection Options — Obstacles — Types of Evidence — The Rules of Evidence — Volatile Evidence — General Procedure — Collection and Archiving — Methods of Collection — Artifacts — Collection Steps — Controlling Contamination: The Chain of Custody Duplication and Preservation of Digital Evidence: Preserving the Digital Crime Scene — Computer Evidence Processing Steps — Legal Aspects of Collecting and Preserving Computer Forensic Evidence Computer Image Verification and Authentication: Special Needs of Evidential Authentication — Practical Consideration — Practical Implementation.

#### **UNIT – IV:**

**Computer Forensics Analysis and Validation:** Determining what data to collect and analyze, validating forensic data, addressing data-hiding techniques, performing remote acquisitions Network Forensics: Network forensics overview, performing live acquisitions, developing standard procedures for network forensics, using network tools, examining the honeynet project. Processing Crime and Incident Scenes: Identifying digital evidence, collecting evidence in private-sector incident scenes, processing law enforcement crime scenes, preparing for a search, securing a computer incident or crime scene, seizing digital evidence at the scene, storing digital evidence, obtaining a digital hash, reviewing a case.

#### **UNIT – V:**

**Current Computer Forensic Tools:** Evaluating computer forensic tool needs, computer forensics software tools, computer forensics hardware tools, validating and testing forensics software E-Mail Investigations: Exploring the role of e-mail in investigation, exploring the roles of the client and server in e-mail, investigating e-mail crimes and violations, understanding e-mail servers, using specialized e-mail forensic tools.

**Cell Phone and Mobile Device Forensics:** Understanding mobile device forensics, understanding acquisition procedures for cell phones and mobile devices.

#### **UNIT – VI:**

**Working with Windows and DOS Systems:** understanding file systems, exploring Microsoft File Structures, Examining NTFS disks, Understanding whole disk encryption, windows registry, Microsoft startup tasks, MS-DOS startup tasks, virtual machines.

#### **TEXT BOOKS:**

1. Computer Forensics, Computer Crime Investigation, John R. Vacca, Firewall Media, New Delhi
2. Computer Forensics and Investigations, Nelson, Phillips Enfinger, Stuart, CENGAGE Learning
3. Real Digital Forensics, Keith J. Jones, Richard Bejtlich, Curtis W. Rose, Addison Wesley, Pearson Education

#### **REFERENCES:**

1. Forensic Compiling, A Practitioners Guide, Tony Sammes and Brian Jenkinson, Springer International Edition
2. Computer Evidence Collection & Presentation, Christopher L. T. Brown, Firewall Media
3. Homeland Security, Techniques & Technologies, Jesus Mena, Firewall Media
4. Software Forensics Collecting Evidence from the Scene of a Digital Crime, Robert M. Slade, TMH 2005
5. Windows Forensics, Chad Steel, Wiley India Edition

# **DATA SCIENCES / BIG DATA AND ANALYTICS**

## DATA SCIENCES / BIG DATA AND ANALYTICS

**Data science** helps in risk evaluation and observing, possible deceitful comportment, payments, customer analysis, and experience, among much other exploitation. The capability to make **data**-driven choices generates a steadier financial situation and **data scientists** make the strength of the **industry**.

As such, **data science** track helps students to apply business concepts in banking, finance, manufacturing, transport, e-commerce, education, etc. that use **data science**. As a consequence, there are numerous **Data Science** Applications associated to it

### Job Roles in Data Science Track

- [Data Analyst](#)
- [Data Engineers](#)
- [Database Administrator](#)
- [Machine Learning Engineer](#)
- [Data Scientist](#)
- [Data Architect](#)
- [Statistician](#)
- [Business Analyst](#)
- [Data and Analytics Manager](#)

**Big Data analytics** track helps the students to learn the process of gathering, establishing and examining large sets of **data** (called **Big Data**) to determine patterns and other beneficial information. Analysts occupied with **Big Data** characteristically want the acquaintance that comes from investigating the **data**.

Big data analytics is the practice of mining useful information by examining different **types** of big data sets. Big data analytics is utilized to determine concealed patterns, market developments and consumer favorites, for the advantage of organizational decision making.

### Job responsibilities in a Big Data Analytics Track are

- To gather and accumulate data from disparate sources, clean it, organize it, process it, and analyse it to extract valuable insights and information.
- To identify new sources of data and develop methods to improve data mining, analysis, and reporting.
- To create data definitions for new database files or alterations made to the already existing ones for analysis purposes.
- To present the findings in reports (in table, chart, or graph format) to help the management team in the decision-making process.
- To apply statistical analysis methods for consumer data research and analysis purposes.
- To keep track of the trends and correlational patterns among complex data sets.
- To perform routine analysis tasks to support day-to-day business functioning and decision making.
- To collaborate with Data Scientists to develop innovative analytical tools.
- To work in close collaboration with both the IT team and the business management team to accomplish company goals.

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(A19OE1MT02) STATISTICAL METHODS FOR DATA SCIENCE

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To provide insights about the basic roles of various statistical methods in building computer applications
- To develop a greater understanding of the importance of Data Visualization techniques
- To develop problem-solving skills
- To make inferences about the population parameters using sample data
- To provide an understanding on the importance and techniques of predicting a relationship between the two sets of data and determine the goodness of fitted model

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Analyze an extremely large data set and perform exploratory data analysis to extract meaningful insights

**CO-2:** Develop various visualizations of the data in hand and communicate results of analysis effectively (visually and verbally)

**CO-3:** Examine a real-world problem and solve the same with the knowledge gained from various distributions study

**CO-4:** Use and fit a linear regression model to data and use it for prediction

**CO-5:** Fit a polynomial regression model to data and use it for prediction

**UNIT – I:**

**Introduction to Statistics:** Definition of statistics, basic objectives, applications in various branches of science with examples, collection of data: internal and external data, primary and secondary data, population and sample, representative sample.

**UNIT – II:**

**Descriptive Statistics:** Classification and tabulation of univariate data, graphical representation, frequency curves, descriptive measures - central tendency and dispersion, bivariate data, summarization, marginal and conditional frequency distribution.

**UNIT – III:**

**Introduction to R:** Introduction, Installing R and data types in R, programming using R: operators, conditional statements, looping, scripts, function creation, creating list, list operations, recursive list, creating a data frame, operations on data frames.

#### **UNIT – IV:**

**Data Visualization using R:** Import - export of data, measures of central tendency and measures of dispersion, data visualization – scatter plot, pie chart, histogram, bar chart, box plot, absolute and relative frequencies, frequency distribution.

#### **UNIT – V:**

##### **Correlation & Linear Regression:**

**Correlation:** Correlation, types of correlation, coefficient of correlation, rank correlation coefficient.

**Linear Regression:** Introduction, regression model, interval estimation, estimation of parameters of  $\beta_0$  and  $\beta_1$ , Estimation of  $\sigma^2$ .

#### **UNIT – VI:**

**Non-Linear Regression:** Regression of second-degree polynomial (non-linear least square method for polynomial function), power function, exponential, estimation of coefficients, linear and polynomial regressions in R.

#### **TEXT BOOKS:**

1. Introductory Statistics, Thomas H. Wonnacott & Ronald J. Wonnacot, John Wiley & Sons, 1969
2. Applied Statistics and Probability for Engineers, Douglas C. Montgomery, George C. Runger, 3<sup>rd</sup> Edition, John Wiley & Sons, 2003
3. R for Beginners, Sandip Rakshit, 1<sup>st</sup> Edition, McGraw-Hill Education, 2017

#### **REFERENCES:**

1. R-The Statistical Programming Language, Dr. Mark Gardner, Wiley India, 2013
2. Introduction to the Theory of Statistics, A. M. Mood, F. A. Graybill and D. C. Boes, 3<sup>rd</sup> Edition, McGraw-Hill Education, 2017
3. Introduction of Probability Models, S. M. Ross, 11<sup>th</sup> Edition, Academic Press, N.Y., 2014
4. Statistical Methods, S. P. Gupta, 42<sup>nd</sup> Revised Edition, Sultan Chand & Sons, 2012



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(A19OE1IT03) COMPUTATIONAL THINKING USING PYTHON

**COURSE PRE-REQUISITES:** Statistical Methods for Data Science

**COURSE OBJECTIVES:**

- To understand why Python is a useful scripting language for developers
- To create and execute Python programs and to Learn how to use lists, tuples, and dictionaries in Python programs
- To learn how to build and package Python modules for reusability
- To learn how to design object-oriented programs with Python classes
- To learn how to use exception handling in Python applications for error handling

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Adapt and combine standard algorithms to solve a given problem (includes numerical as well as non-numerical algorithms)

**CO-2:** Adequately use standard programming constructs: repetition, selection, functions, composition, modules, aggregated data (arrays, lists, etc.)

**CO-3:** Explain what a given program (in Python) does identify and repair coding errors in a program

**CO-4:** Understand and use object-based software concepts (constructing OO software will be dealt with in the course Software Engineering)

**CO-5:** Use library software for (e.g.) building a graphical user interface, web application, or mathematical software

**UNIT – I:**

**Introduction:** History, Features, Setting up path, Working with Python, Basic Syntax, Variable and Data Types, Operator, Conditional Statements-If

If- else Nested if-else Looping for While Nested loops Control Statements Break Continue Pass String Manipulation Accessing Strings Basic Operations String slices Function.

**UNIT – II:**

**Methods, Lists:** Introduction, Accessing list, Operations, Working with lists, Function and Methods,

**Tuple:** Introduction, Accessing tuples, Operations, Working, Functions and Methods

**Dictionaries:** Introduction, Accessing values in dictionaries, Working with dictionaries, Properties.

**UNIT – III:**

**Functions:** Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables.

**Modules:** Creation, Importing module, Math module, Random module, Packages.

**UNIT – IV:**

**Composition:** Input-Output-Printing on screen, Reading data from keyboard, Opening and closing file Reading and writing files, Functions.

**Exception Handling:** Exception, Exception Handling, Except clause, Try? Finally clause, User Defined Exceptions

**UNIT – V:**

**OOPs Concept:** Class and object, Attributes, Inheritance, Overloading, Overriding, Data hiding, Regular expressions- Match function, Search function, Matching VS Searching, Modifiers, Patterns.

**Multithreading:** Thread, Starting a thread, Threading module, Synchronizing threads.

**CGI:** Introduction, Architecture, CGI environment variable, GET and POST methods, Cookies, File upload.

**UNIT – VI:**

**Database:** Introduction, Connections, Executing queries, Transactions Handling error,

**Networking:** Socket, Socket Module, Methods, Client and server, Internet modules, Sending email.

**TEXT BOOKS:**

1. Learning Python, David Ascher and Mark Lutz, O'Reilly

**REFERENCES:**

1. Python Programming: An Introduction to Computer Science, John M. Zelle, 2<sup>nd</sup> Edition, Kindle Edition
2. Python Essential Reference, David M. Beazley, 4<sup>th</sup> Edition, Developer's Library

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(A19OE1IT04) FUNDAMENTALS OF DATA MINING

**COURSE PRE-REQUISITES:** Statistical Methods for Data Science, Computational Thinking using Python

**COURSE OBJECTIVES:**

- To introduce the basic concepts and techniques in building a Data Warehouse
- To apply preprocessing methods for any given raw data
- To develop skills of using recent data mining software for solving practical problems
- To implement and apply basic algorithms for supervised and unsupervised learning

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Assess raw input data and process it to provide suitable input for a range of data mining algorithms.

**CO-2:** Discover and measure interesting patterns from different kinds of databases

**CO-3:** Evaluate and select appropriate data-mining algorithms and apply, interpret and report the output appropriately

**CO-4:** Design and implement data-mining applications using sample, realistic data sets and modern tools

**UNIT – I:**

**Data Warehousing & Modeling:** Basic Concepts: Data Warehousing: A multitier Architecture, Data warehouse models: Enterprise warehouse, Data mart and virtual warehouse, Extraction, Transformation and loading.

**UNIT – II:**

**Data Cube:** A multidimensional data model, Stars, Snowflakes and Fact constellations: Schemas for multidimensional Data models, Dimensions: The role of concept Hierarchies, Measures: Their Categorization and computation, Typical OLAP Operations.

**UNIT – III:**

**Data Warehouse Implementation & Data Mining:** Data Warehouse Architecture, What is data mining, Challenges, From Data Warehousing and Data Mining, Data Mining Tasks, Data Mining Functionalities, Major Issues in Data Mining. Data: Types of Data, Data Quality, Data Pre-processing, Measures of Similarity and Dissimilarity.

**UNIT – IV:**

**Association Analysis:** Association Analysis: Problem Definition, Frequent Item set Generation, Rule generation. Alternative Methods for Generating Frequent Item sets, FP-Growth Algorithm, Evaluation of Association Patterns.

**UNIT – V:**

**Classification:** Decision Trees Induction, Method for Comparing Classifiers, Rule Based Classifiers, Nearest Neighbor Classifiers, Bayesian Classifiers.

**UNIT – VI:**

**Clustering Analysis:** Overview, K-Means, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation, Density-Based Clustering, Graph- Based Clustering, Scalable Clustering Algorithms.

**TEXT BOOKS:**

1. Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach, Vipin Kumar, First Impression, Pearson, 2014
2. Data Mining-Concepts and Techniques, Jiawei Han, Micheline Kamber, Jian Pei, 3<sup>rd</sup> Edition, Morgan Kaufmann, 2012

**REFERENCES:**

1. Data Warehousing in the Real World, Sam Anahory, Dennis Murray, Tenth Impression, Pearson, 2012
2. Mastering Data Mining, Michael J. Berry, Gordon S. Linoff, 2<sup>nd</sup> Edition, Wiley, 2012

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(A19OE1IT05) DATA ANALYSIS AND VISUALIZATION

**COURSE PRE-REQUISITES:** Statistical Methods for Data Science, Computational Thinking using Python, Fundamentals of Data Mining

**COURSE OBJECTIVES:**

- To introduce concept and characteristics of probability distribution
- To introduce underlying design principles, properties and assumptions of linear and non-linear regression modelling
- To introduce design principles involved in identifying interesting classification and prediction of data patterns
- To introduce properties of time series data and perform time series analysis

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Apply probability distribution concepts to identify univariate data patterns

**CO-2:** Apply regression modelling to build efficient mathematical models for prediction and classification

**CO-3:** Apply decision and regression trees for supervised learning

**CO-4:** Visualize time series data by applying time series techniques

**UNIT – I:**

**Data Definitions and Analysis Techniques:** Elements, Variables, and Data categorization, Introduction to statistical learning, Descriptive Statistics: Measures of central tendency, Measures of location of dispersions.

**UNIT – II:**

**Basic Analysis Techniques:** Basic analysis techniques, Statistical hypothesis generation and testing, Chi-Square test, t-Test Analysis of variance, Correlation analysis, Maximum likelihood test.

**UNIT – III:**

**Data Analysis Techniques:** Regression analysis and visualization, Classification techniques and visualization, Clustering and visualization, Association rules analysis and visualization

**UNIT – IV:**

**Time-series Analysis and Forecasting:** Time-series components, Variation in Time Series, Cyclic Variation, Seasonal Variation, Irregular Variation.

**UNIT – V:**

**Smoothing Techniques:** A problem involving all four components of time series, Introduction to forecasting, forecasting models, Trend and Seasonal effects, Trend Analysis

**UNIT – VI:**

**Case-studies and Projects:** Understanding business scenarios, Feature engineering and visualization, Sensitivity Analysis.

**TEXT BOOKS:**

1. Data Mining and Analysis, Mohammed J. Zaki, Wagner Meira, Cambridge, 2012
2. Data Mining: Theories, Algorithms, and Examples, Nong Ye, CRC Press Taylor & Francis Group, 2014
3. Statistics for Management, David S. Rubin, Sanjay Rastogi, Masood Husain Siddiqui Richard I. Levin, 7<sup>th</sup> Edition, Pearson Learning

**REFERENCES:**

1. Probability & Statistics for Engineers & Scientists, Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, 9<sup>th</sup> Edition, Prentice Hall
2. The Elements of Statistical Learning, Data Mining, Inference and Prediction, Trevor Hastie, Robert Tibshirani, Jerome Friedman, 2<sup>nd</sup> Edition, Springer, 2014
3. An Introduction to Statistical Learning Mining Massive Data Sets, A. Rajaraman and J. Ullman, Cambridge University Press, 2012
4. Software for Data Analysis: Programming with R (Statistics and Computing), John M. Chambers, Springer

# **AUTONOMOUS VEHICLES**

## **AUTONOMOUS VEHICLES**

The invention of the wheel marked a large step in the evolution of mankind. With mobility, man experienced a newfound freedom that opened the doors for several other inventions. Automobile engineering or automotive engineering is one of the most challenging careers in the field of engineering with a wide scope. This branch deals with the designing, developing, manufacturing, testing and servicing automobiles such as cars, trucks, motorcycles, scooters, etc. and the related engineering sub systems. For the perfect blend of designing and manufacturing automobiles, automobile engineering uses the features of different elements of engineering such as mechanical, electrical, electronic, instrumentation, civil, software and safety engineering. Exploring the topic from an interdisciplinary perspective is indispensable. Globalization and incredible growth of automobile industry have resulted in numerous opportunities for engineers both in India and abroad.

The 17<sup>th</sup> and 18<sup>th</sup> centuries were mostly about steam-powered vehicles transporting people and goods. While electric cars enjoyed popularity in the 19<sup>th</sup> and early 20<sup>th</sup> centuries, the later period saw the accelerated adoption of the petrol car, due to its advantages of power, mass production, cost and advances in the internal combustion engine. It is only in the 21<sup>st</sup> century that interest in electric cars has come back, given the need for cleaner, greener modes of transport. The modern period is associated with several path breaking technologies. Over the last couple of decades, there has been an explosion of electronics in vehicles. Connected cars that include technology features are ever more popular. These smart cars come with internet access, GPS, wi-fi, superior infotainment, advanced telematics and navigation capabilities. More innovations in in-vehicle infotainment and electronics promise to give car users even more enhanced capabilities in the near future.

Today, safety has become a larger concern than ever before. While entertainment and infotainment have made car driving a pleasure, this has also given rise to a growing tribe of distracted drivers. Add to this, underdeveloped roads, which take a toll on drivers today. Increased distractions and fatigue can also contribute to human fatalities. The future certainly points in the direction of driverless cars, which promise to alleviate concerns of traffic congestion and road safety. Driverless cars, also known as autonomous cars, will usher in a paradigm shift in the evolution of the modern automobile. Self-driving cars can sense the environment and traffic with the help of RADAR, LIDAR, GPS and computer vision and navigate without human intervention. Autonomous cars are claimed to have greater accuracy, reliability and faster reaction time compared to human drivers. This would lead to fewer traffic collisions and less road congestion.

Autonomous driving is a popular subject of today's discussion and automakers are developing complex systems that allow cars to drive themselves. If technology continues on its current course, car will do the concentrating for you. Self-parking, automatic emergency braking, adaptive cruise control and lane keeping are just some of the technologies that have leapt into the market in the past few years. Put them all together, get a picture of driving to assisted driving to



fully autonomous cars. The open elective track "Autonomous Vehicles" offered by the department of automobile engineering trains the students to meet the technological challenges and diverse needs of the industry and society in various areas of automobile engineering and equips them to excel in a truly competitive industry. With thorough knowledge in this field, engineering graduates get opportunity to serve many top-notch automobile companies and IT companies as well.

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B.Tech. V Semester

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(A19OE1AE01) PRINCIPLES OF AUTOMOBILE ENGINEERING

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To understand the layout of an automobile and functionalities subsystems
- To provide overview on concepts of engine, cooling, lubrication and fuel systems
- To present constructional features and working of automotive driveline and running systems
- To study the fundamentals and principles of automotive electrical systems

**COURSE OUTCOMES** After completion of the course, the student should be able to

**CO-1:** Explain the functionalities of automotive systems and subsystems

**CO-2:** Give an overview on engine and engine subsystems.

**CO-3:** Describe working of automotive driveline and running systems

**CO-4:** Discuss the concepts of automotive starting, ignition and charging systems

**UNIT – I:**

**Introduction:** Classification of automobiles, layout of an automobile, automobile sub systems and their role. Types of chassis, role and requirement of a chassis frame, types of frames, materials, loading points and types of bodies.

**UNIT – II:**

**Engine:** Classification and components of an engine, principle and working of four stroke and two stroke SI and CI engines, petrol fuel system - carburetor, diesel fuel system - diesel fuel pump, injectors, introduction to electronic fuel injection system – MPFI and CRDI.

**UNIT – III:**

**Cooling and Lubrication:** Necessity of cooling, air-cooling, water cooling - thermosyphon and pump cooling, radiator, pump, thermostat, antifreeze solution and radiator fan. Mist, splash and forced lubrication, oil filters and oil pumps.

**UNIT – IV:**

**Drive Line:** Clutches, principle, single plate clutch, multi plate clutch and centrifugal clutch. Gear box - Need, sliding mesh, constant mesh and synchromesh gear box. Propeller shaft, universal joint, differential, wheels and tyres.

**UNIT – V:**

**Running Systems:** Suspension systems – Objective, rigid axle and independent suspension system and torsion bar. Steering system – Layout, steering mechanism,

steering geometry and steering gear boxes. Brake system –Principle, stopping distance, types of brakes and actuation.

**UNIT – VI:**

**Electrical Systems:** Starting system - Principle, working of different starter drive units and solenoid switches. Ignition system - Conventional ignition system types, ignition advance and retarding mechanisms. Charging system – Alternator principle, construction and working, cut-outs and regulators.

**TEXT BOOKS:**

1. Advanced Vehicle Technology, Heinz Heisler, Butterworth Heinemann, 2002
2. Automobile Electrical Equipment, Crouse W. H., 3<sup>rd</sup> Edition, McGraw-Hill, 1986

**REFERENCES:**

1. Motor Vehicle, Garrett T. K., Newton K., Steeds W. ButterWorths & Co., 2001
2. Automotive Electrical Equipment, Kohli P. L., Tata McGraw-Hill, 1975
3. Automotive Chassis and Body, Crouse W. H., 5<sup>th</sup> Edition, McGraw-Hill, 1976
4. Automotive Mechanics, Giri N. K., Khanna Publications, 2006

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| <b>(A19OE1AE02) MODERN AUTOMOTIVE TECHNOLOGIES</b> |   |       |   |

**COURSE PRE-REQUISITES:** Principles of Automobile Engineering

**COURSE OBJECTIVES:**

- To provide an overview on advanced engine control system concepts
- To know the interdisciplinary concepts and intelligent automotive systems
- To understand the interdisciplinary concepts and GPS-enabled applications in automobile
- To present intelligent vehicle technologies like comfort, safety and security systems

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Apply advanced engine control system concepts in engineering

**CO-2:** Discuss the need for implementation intelligent vehicle technologies

**CO-3:** Address the key technologies in automotive navigation

**CO-4:** Appreciate the technological advancements driver assistance systems

**UNIT – I:**

**Advanced Engine Controls:** Concept of an electronic engine control system, engine control module, powertrain control module, electronic fuel injection - throttle body fuel injection, multi-point fuel injection, gasoline direct injection, common rail direct injection, electronic ignition control, engine mapping, on-board diagnostics.

**UNIT – II:**

**Introduction to Intelligent Vehicles:** Driver information, driver perception, driver convenience, driver monitoring, general vehicle control, longitudinal and lateral control, collision avoidance, vehicle monitoring.

**UNIT – III:**

**Telematics:** Global positioning system, geographical information systems, navigation system, architecture, automotive vision system, road recognition.

**UNIT – IV:**

**Comfort Systems:** Adaptive cruise control system, active suspension system, power steering, collapsible and tiltable steering column, power windows.

**UNIT – V:**

**Safety Systems:** Active and passive safety, airbags, seat belt tightening system, forward collision warning systems, child lock, anti-lock braking systems, traction control system, lane departure warning system.

**UNIT – VI:**

**Security Systems:** Anti-theft technologies – mechanical, electromechanical and electronic immobilizers, alarm system, stolen vehicle tracking system, remote keyless entry, smart card system, number plate coding.

**TEXT BOOKS:**

1. Understanding Automotive Electronics, William B. Ribbens, 5<sup>th</sup> Edition, Butterworth Heinemann, 1998
2. Intelligent Vehicle Technologies: Theory and Applications, Ljubo Vlacic, Michel Parent and Fumio Harashima, Butterworth-Heinemann, Oxford, 2001

**REFERENCES:**

1. Automotive Handbook, Robert Bosch, 5<sup>th</sup> Edition, SAE, 2000
2. Navigation and Intelligent Transportation Systems – Progress in Technology, Ronald K. Jurgen, Automotive Electronics Series, SAE, USA, 1998
3. Understanding Automotive Electronics, Bechhold, SAE, 1998

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

B.TECH. VII Semester

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(A19OE1AE03) ELECTRIC, HYBRID AND FUEL CELL VEHICLES

**COURSE PRE-REQUISITES:** Principles of Automobile Engineering, Modern Automotive Technologies

**COURSE OBJECTIVES:**

- To study the concepts and drivetrain configurations of electric and hybrid vehicles
- To understand about electric propulsion system
- To provide various energy storage devices
- To present principle, working and automotive applications of fuel cell and solar technology

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Explain the concepts and drivetrain configurations of electric and hybrid vehicles

**CO-2:** Discuss various electric motors and controls

**CO-3:** Present various energy storage devices

**CO-4:** Describe automotive applications of fuel cell and solar technology

**UNIT – I:**

**Electric Vehicles:** Layout of an electric vehicle, system components, traction motor characteristics, transmission, electronic control system, advantage and limitations, performance and energy consumption of electric vehicles.

**UNIT – II:**

**Hybrid Vehicles:** Concepts of hybrid electric drivetrain based on hybridization and powertrain configuration, architecture of series, parallel and series-parallel hybrid electric drivetrains, modes of operation, merits and demerits, plug-in hybrid architecture, speed and torque coupling of hybrid electric drivetrains.

**UNIT – III:**

**Electric Motors:** Review of technology suited to automotive propulsion, requirements, DC motors, Induction motors, permanent magnet brushless DC motors and switched reluctance motors.

**UNIT – IV:**

**Motor Drives:** Speed and torque control, DC motor - Chopper based four quadrant operations, induction motor, permanent magnet motor and switched reluctance motor.

**UNIT – V:**

**Energy Storages:** Electromechanical batteries - Types, parameters, lead acid batteries, nickel-based batteries, lithium-based batteries, battery management system and ultracapacitors.

**UNIT – VI:**

**Fuel Cell and Solar Vehicles:** Fuel cell vehicle – Operating principle, types of fuel cells, fuel cell options for fuel cell vehicle and fuel cell hybrid vehicle. Solar vehicle - Solar photovoltaic cell, solar array, solar car electrical system and drive train.

**TEXT BOOKS:**

1. Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, CRC Press, 2004
2. Electric Vehicle Technology-Explained, James Larminie and John Louny, John Wiley, 2003

**REFERENCES:**

1. Electric and Hybrid Vehicles – Design Fundamentals, Iqbal Husain, CRC Press, 2010
2. Electric Vehicle Battery Systems, Sandeep Dhameja, Butterworth–Heinemann, 2002
3. Electric and Hybrid – Electric Vehicles, Ronald K. Jurgen, SAE, 2002
4. Light Weight Electric/Hybrid Vehicle Design, Ron Hodkinson and John Fenton, Butterworth–Heinemann

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

B.Tech. VIII Semester

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**(A19OE1AE04) CONNECTED AND AUTONOMOUS VEHICLES**

**COURSE PRE-REQUISITES:** Principles of Automobile Engineering, Modern Automotive Technologies, Electric, Hybrid and Fuel Cell Vehicles

**COURSE OBJECTIVES:**

- To understand the fundamentals of vehicle communication and networking
- To provide state-of-the-art in wireless communication technology within and between vehicles
- To know various levels of vehicle autonomy and intelligent automotive systems
- To provide an overview on driver-assist and self-driving processes

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Present the fundamentals of vehicle communication and networking

**CO-2:** Appreciate intra-vehicle and inter-vehicle communication technologies

**CO-3:** Describe various levels of vehicle autonomy

**CO-4:** Discuss the driver-assist and self-driving processes

**UNIT – I:**

**Introduction to Vehicle Communications:** Intra-vehicle communications - communications protocols, systems and sensors (Braking, steering, power train, chassis systems, body electronics, instrument clusters, infotainment systems), inter-vehicle communications - cooperative driving (accident warning, frontal/rear collision prevention, lane change, assistance). Consumer assistance – traffic information, multimedia support and smart parking

**UNIT – II:**

**Communication Fundamentals and Controller Area Network:** Communication fundamentals – Frequency, bandwidth, power measurement, signal to noise ratio, transmission rate constraints, radio frequency spectrum allocation, RADAR operation and types of RADAR. CAN evolution, versions, types of controllers, layered architecture. CAN bus, message frames and error handling.

**UNIT – III:**

**Intra-Vehicle Communications:** Wired communication – Network comparison, two tier approach, LIN applications - Localized vehicle area support, general support areas, CAN applications - In vehicle operation, infotainment, wireless communication – Bluetooth vehicle applications, satellite services – satellite radio, vehicle care and traffic status.



#### **UNIT – IV:**

**Inter-Vehicle Communication:** Adhoc Communications –Applications in Vehicle traffic Monitoring, Collision and congestion avoidance, Highway lane reservation, Emission Control, Vehicle Frequency Utilization – AM Radio, Bluetooth, FM Radio, GPS, Short range RADAR, Wireless LAN, Intelligent Roadway-Infrastructure to vehicle and vehicle to vehicle communications. Evolving smart vehicle – ECU, wireless networking, forward RADAR, side RADAR, GPS, cellular transmission and event Recorder.

#### **UNIT – V:**

**Autonomous Vehicles:** Importance, levels of automation, policy making, social costs, safety and crashes, congestion, land use, energy and emissions, costs and disadvantages

#### **UNIT – VI:**

**Current State of Autonomous Vehicles:** Research, challenges, commercial development, sensor systems, sensor suits, environmental challenges, graceful degradation, V2V and V2I communication, sharing the drive, integrity, security, verification and policy implications.

#### **TEXT BOOKS:**

1. Inter and Intra Vehicle Communications, Gilbert Held Auerbach, 2008
2. Autonomous Vehicle Technology-A Guide for Policymakers, James M. Anderson, Nidhi Kalra, Karlyn D. Stanley, Paul Sorensen, Constantine Samaras, Oluwatobi A. Oluwatola, RAND Corporation, Santa Monica, 2016
3. Autonomous Driving - Technical, Legal and Social Aspects, Markus Maurer, J. Christian Gerdes, Barbara Lenz, Hermann Winner, Editors, Springer, 2016

#### **REFERENCES:**

1. Intelligent Vehicle Technologies: Theory and Applications, Ljubo Vlacic, Michel Parent and Fumio Harashima, Butterworth-Heinemann, Oxford, 2001
2. Navigation and Intelligent Transportation Systems – Progress in Technology, Ronald K. Jurgen, Automotive Electronics Series, SAE, USA, 1998
3. Automotive In-vehicle Networks, J. Gabrielleen, Wiley-Blackwell, 2008
4. In-Vehicle Network Architecture for the Next-Generation Vehicles, Syed Masud Mahmud, IGI
5. Communication Technologies for Vehicles, Mohamed Kassab Springer, 2015

# **GENERAL - COMPUTING**

## 1. PROGRAMMING THROUGH JAVA

**Java** is an extensively **used** programming language specifically intended for use in the distributed environment of the internet. **Java** help students to create wide-ranging applications that possibly will run on a single workstation or be distributed among servers and clients in a network.

Java is an extremely fruitful language and an upper option for many developers for many years. The motive that it has remained so prevalent is since it still happens the needs of functioning across networks.

### **Students will have different roles and responsibilities by learning Java Programming**

- Designing, implementing, and maintaining Java applications that are often high-volume and low-latency, required for mission-critical systems.
- Delivering high availability and performance.
- Contributing in all phases of the development lifecycle.
- Writing well-designed, efficient, and testable code.

## 2. RELATIONAL DATABASE MANAGEMENT SYSTEMS

A relational database permits you to effortlessly find precise information. It also consents you to sort based on any field and produce reports that comprise only definite fields from each record. With features like, Data Accuracy, Easy Access to Data, Data Integrity, Flexibility, Normalization, High Security, Feasible for Future Modifications

### **By learning RDBMS Students will have different roles in Database environment**

- Data Administrator,
- Database Administrator
- Database Designer
- Application Programmer

## 3. COMPUTATIONAL THINKING USING PYTHON

The **python** language is one of the utmost accessible programming languages available because it has streamlined syntax and not complex, which gives more importance on natural language. Due to its comfort of learning and practice, **python** codes can be readily written and executed much quicker than former programming languages.

Data Science: The libraries and frameworks Python offers, e.g. PyBrain, PyMySQL, and NumPy are one of the big reasons. Another reason is diversity. Python experience allows you to do a lot more than any other language, e.g. you can create scripts to automate stuff, go into web development, and so much more.

### **Students will have various Job Profiles by learning Python**

- Software Engineer.
- Python Developer.
- Research Analyst.
- Data Analyst.
- Data Scientist.

- Software Developer.

#### **4. INTRODUCTION TO DATA ANALYTICS**

**Data** Scientists and Analysts **use data analytics** techniques in their research, and businesses also **use** it to inform their conclusions. **Data analysis** can assistance corporations healthier comprehend their customers, assess their ad-campaigns, personalize gratified, create content approaches and progress products.

#### **By learning Data Analytics students will get Jobs with different designations**

- IT Systems Analyst. Systems analysts use and design systems to solve problems in information technology. ...
- Healthcare Data Analyst. ...
- Operations Analyst. ...
- Data Scientist. ...
- Data Engineer. ...
- Quantitative Analyst. ...
- Data Analytics Consultant. ...
- Digital Marketing Manager.

## VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

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### (A19OE1IT06) PROGRAMMING THROUGH JAVA

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To introduces object-oriented programming concepts using the Java language
- To introduces the principles of inheritance and polymorphism; and demonstrates how they relate to the design of abstract classes
- To introduces the implementation of packages and interfaces
- To introduces exception handling, event handling and multithreading

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Develop applications for range of problems using object-oriented programming techniques

**CO-2:** Design simple graphical user interface applications

**CO-3:** Explore the design of graphical user interface using applets and swings

**UNIT – I:**

**Object Oriented Thinking and Java Basics:** Need for OOP Paradigm, Summary of OOP Concepts, Coping with Complexity, Abstraction Mechanisms, A Way of Viewing World – Agents, Responsibility, Messages, Methods, History of Java, Java Buzzwords, Data Types, Variables, Scope and Life Time of Variables, Arrays, Operators, Expressions, Control Statements, Type Conversion and Casting, Simple Java Program, Concepts of Classes, Objects, Constructors, Methods, Access Control, This Keyword, Garbage Collection, Overloading Methods and Constructors, Method Binding, Inheritance, Overriding and Exceptions, Parameter Passing, Recursion, Nested and Inner Classes, Exploring String Class.

**UNIT – II:**

**Inheritance, Packages and Interfaces:** Hierarchical Abstractions, Base Class Object, Subclass, Subtype, Substitutability, Forms of Inheritance- Specialization, Specification, Construction, Extension, Limitation, Combination, Benefits of Inheritance, Costs of Inheritance. Member Access Rules, Super Uses, Using Final with Inheritance, Polymorphism- Method Overriding, Abstract Classes, The Object Class.

Defining, Creating and Accessing a Package, Understanding Classpath, Importing Packages, Differences between Classes and Interfaces, Defining an Interface, Implementing Interface, Applying Interfaces, Variables in Interface and Extending Interfaces, Exploring Java.IO.

### **UNIT – III:**

**Exception Handling and Multi-threading:** Concepts of Exception Handling, Benefits of Exception Handling, Termination or Resumptive Models, Exception Hierarchy, Usage of Try, Catch, Throw, Throws and Finally, Built in Exceptions, Creating Own Exception Sub Classes.

String Handling, Exploring Java. Util, Differences between Multi-Threading and Multitasking, Thread Life Cycle, Creating Threads, Thread Priorities, Synchronizing Threads, Interthread Communication, Thread Groups, Daemon Threads. Enumerations, Autoboxing, Annotations, Generics.

### **UNIT – IV:**

**Event Handling:** Events, Event Sources, Event Classes, Event Listeners, Delegation Event Model, Handling Mouse and Keyboard Events, Adapter Classes.

The AWT Class Hierarchy, User Interface Components- Labels, Button, Canvas, Scrollbars, Text Components, Check Box, Check Box Groups, Choices, Lists Panels – Scrollpane, Dialogs, Menubar, Graphics, Layout Manager – Layout Manager Types – Border, Grid, Flow, Card and Grid Bag.

### **UNIT – V:**

**Applets:** Concepts of Applets, Differences between Applets and Applications, Life Cycle of an Applet, Types of Applets, Creating Applets, Passing Parameters to Applets.

### **UNIT – VI:**

**Swing:** Introduction, Limitations of AWT, MVC Architecture, Components, Containers, Exploring Swing- Japplet, JFrame and JComponent, Icons and Labels, Text Fields, Buttons – The JButton Class, Check Boxes, Radio Buttons, Combo Boxes, Tabbed Panes, Scroll Panes, Trees, and Tables.

### **TEXT BOOKS:**

1. Java The Complete Reference, Herbert Schildt, 7<sup>th</sup> Edition, TMH
2. Understanding OOP with Java Updated Edition, T. Budd, Pearson Education
3. An Introduction to Programming and OO Design using Java, J. Nino and F. A. Hosch, John Wiley & Sons

### **REFERENCES:**

1. Introduction to Java Programming, Y. Daniel Liang, Pearson Education
2. An Introduction to Java Programming and Object-Oriented Application Development, R. A. Johnson, Thomson
3. Core Java 2, Vol. 1 - Fundamentals, Cay S. Horstmann and Gary Cornell, 8<sup>th</sup> Edition, Pearson Education
4. Core Java 2, Vol. 2 - Advanced Features, Cay S. Horstmann and Gary Cornell, 8<sup>th</sup> Edition, Pearson Education

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(A19OE1CS08) RELATIONAL DATABASE MANAGEMENT SYSTEMS

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To understand the basic concepts and the applications of database systems
- To master the basics of SQL and construct queries using SQL
- To understand the relational database design principles
- To become familiar with the basic issues of transaction processing and concurrency control
- To become familiar with database storage structures and access techniques

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Demonstrate the basic elements of a relational database management system

**CO-2:** Identify the data models for relevant problems

**CO-3:** Design entity relationship model and convert entity relationship diagrams into RDBMS and formulate SQL queries on the data

**CO-4:** Apply normalization for the development of application software

**UNIT – I:**

**Introduction:** Database System Applications, Purpose of Database Systems, View of Data, Database Languages – DDL, DML, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Data Mining and Information Retrieval, Specialty Databases, Database Users and Administrators, History of Database Systems.

**Introduction to Database Design:** Database Design and ER diagrams, Entities, Attributes and Entity sets, Relationships and Relationship sets, Additional features of ER Model, Conceptual Design with the ER Model, Conceptual Design for Large enterprises.

**Relational Model:** Introduction to the Relational Model, Integrity Constraints over Relations, Enforcing Integrity constraints, Querying relational data, Logical data base Design: ER to Relational, Introduction to Views, Destroying /Altering Tables and Views.

**UNIT – II:**

**Relational Algebra and Calculus:** Preliminaries, Relational Algebra, Relational calculus – Tuple relational Calculus, Domain relational calculus, Expressive Power of Algebra and calculus.

**SQL:** Queries, Constraints, Triggers: Form of Basic SQL Query, UNION, INTERSECT, and EXCEPT, Nested Queries, Aggregate Operators, NULL values Complex Integrity Constraints in SQL, Triggers and Active Data bases, Designing Active Databases.

**UNIT – III:**

**Schema Refinement and Normal Forms:** Introduction to Schema Refinement, Functional Dependencies - Reasoning about FDs, Normal Forms, Properties of Decompositions, Normalization, Schema Refinement in Database Design, Other Kinds of Dependencies.

**UNIT – IV:**

**Transaction Management:** Transactions, Transaction Concept, A Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Transaction Isolation and Atomicity Transaction Isolation Levels, Implementation of Isolation Levels.

**UNIT – V:**

**Concurrency Control:** Lock-Based Protocols, Multiple Granularity, Timestamp-Based Protocols, Validation-Based Protocols, Multiversion Schemes.

Recovery System-Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management, Failure with loss of nonvolatile storage, Early Lock Release and Logical Undo Operations, Remote Backup systems.

**UNIT – VI:**

**Storage and Indexing:** Overview of Storage and Indexing: Data on External Storage, File Organization and Indexing, Index Data Structures, Comparison of File Organizations.

**Tree-Structured Indexing:** Intuition for tree Indexes, Indexed Sequential Access Method (ISAM), B+ Trees: A Dynamic Index Structure, Search, Insert, Delete.

Hash- Based Indexing: Static Hashing, Extendible hashing, Linear Hashing, Extendible vs. Linear Hashing.

**TEXT BOOKS:**

1. Database Management Systems, Raghu Ramakrishnan, Johannes Gehrke, 3<sup>rd</sup> Edition, McGraw-Hill
2. Database System Concepts, A. Silberschatz, Henry F. Korth, S. Sudarshan, 6<sup>th</sup> Edition, McGraw-Hill
3. Database Systems, R. Elmasri, Shamkant B. Navathe, 6<sup>th</sup> Edition, Pearson Education

**REFERENCES:**

1. Database System Concepts, Peter Rob & Carlos Coronel, Cengage Learning
2. Introduction to Database Management, M. L. Gillenson and others, Wiley Student Edition



3. Database Development and Management, Lee Chao, Auerbach Publications, Taylor & Francis Group
4. Introduction to Database Systems, C. J. Date, Pearson Education

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**(A19OE1IT03) COMPUTATIONAL THINKING USING PYTHON**

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To understand why Python is a useful scripting language for developers
- To create and execute Python programs and to Learn how to use lists, tuples, and dictionaries in Python programs
- To learn how to build and package Python modules for reusability
- To learn how to design object-oriented programs with Python classes
- To learn how to use exception handling in Python applications for error handling

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Adapt and combine standard algorithms to solve a given problem (includes numerical as well as non-numerical algorithms)

**CO-2:** Adequately use standard programming constructs: repetition, selection, functions, composition, modules, aggregated data (arrays, lists, etc.)

**CO-3:** Explain what a given program (in Python) does identify and repair coding errors in a program

**CO-4:** Understand and use object-based software concepts (constructing OO software will be dealt with in the course Software Engineering)

**CO-5:** Use library software for (e.g.) building a graphical user interface, web application, or mathematical software

**UNIT – I:**

**Introduction:** History, Features, Setting up path, Working with Python, Basic Syntax, Variable and Data Types, Operator, Conditional Statements-If

If- else Nested if-else Looping for While Nested loops Control Statements Break Continue Pass String Manipulation Accessing Strings Basic Operations String slices Function.

**UNIT – II:**

**Methods, Lists:** Introduction, Accessing list, Operations, Working with lists, Function and Methods,

**Tuple:** Introduction, Accessing tuples, Operations, Working, Functions and Methods

**Dictionaries:** Introduction, Accessing values in dictionaries, Working with dictionaries, Properties.

**UNIT – III:**

**Functions:** Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables.

**Modules:** Creation, Importing module, Math module, Random module, Packages.

**UNIT – IV:**

**Composition:** Input-Output-Printing on screen, Reading data from keyboard, Opening and closing file Reading and writing files, Functions.

**Exception Handling:** Exception, Exception Handling, Except clause, Try? Finally clause, User Defined Exceptions

**UNIT – V:**

**OOPs Concept:** Class and object, Attributes, Inheritance, Overloading, Overriding, Data hiding, Regular expressions- Match function, Search function, Matching VS Searching, Modifiers, Patterns.

**Multithreading:** Thread, Starting a thread, Threading module, Synchronizing threads.

**CGI:** Introduction, Architecture, CGI environment variable, GET and POST methods, Cookies, File upload.

**UNIT – VI:**

**Database:** Introduction, Connections, Executing queries, Transactions Handling error, Networking: Socket, Socket Module, Methods, Client and server, Internet modules, Sending email.

**TEXT BOOKS:**

1. Learning Python, David Ascher and Mark Lutz, 2<sup>nd</sup> Edition, O'Reilly, 2003

**REFERENCES:**

1. Python Programming: An Introduction to Computer Science, John M. Zelle, 2<sup>nd</sup> Edition, Kindle Edition
2. Python Essential Reference, David M. Beazley, 4<sup>th</sup> Edition, Developer's Library

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(A19OE1IT07) INTRODUCTION TO DATA ANALYTICS

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To be exposed to conceptual framework of big data
- To understand different techniques of data analysis
- To be familiar with concepts of data streams
- To be exposed to item sets, clustering, frame works and Visualization

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand big data fundamentals

**CO-2:** Learn various data analysis techniques

**CO-3:** Implement various data streams

**CO-4:** Understand item sets, clustering, frame works & Visualizations

**UNIT – I:**

**Introduction to Big Data:** Introduction to Big Data Platform – Challenges of Conventional systems – Web data – Evolution of Analytic scalability, analytic process and tools, Analysis vs Reporting – Modern data analytic tools,

**Statistical Concepts:** Sampling distributions, resampling, statistical inference, prediction error.

**UNIT – II:**

**Data Analysis:** Regression modeling, Multivariate analysis, Bayesian modeling, inference and Bayesian networks, Support vector and Kernel methods

**Analysis of Time Series:** Linear systems analysis, nonlinear dynamics – Rule induction –

**Neural Networks:** Learning and and Generalisation, competitive learning, Principal component analysis and neural networks

**Fuzzy Logic:** extracting fuzzy models from data, fuzzy decision trees, Stochastic search methods.

**UNIT – III:**

**Mining Data Streams:** Introduction to Streams Concepts – Stream data model and architecture – Stream Computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a Window – Decaying window – Real time Analytics Platform (RTAP) applications – case studies – real time sentiment analysis, stock market predictions.

**UNIT – IV:**

**Frequent Itemsets and Clustering:** Mining Frequent itemsets – Market based Modeling – Apriori Algorithm – Handling large data sets in Main Memory – Limited Pass Algorithm – Counting frequent itemsets in a Stream – Clustering Techniques – Hierarchical – K-Means.

**UNIT – V:**

Clustering high dimensional data – CLIQUE and ProCLUS – Frequent pattern-based clustering methods – Clustering in non-Euclidean space – Clustering for streams and Parallelism.

**UNIT – VI:**

**Frameworks and Visualization:** MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases – S3 – Hadoop Distributed file systems – Visualizations – Visual data analysis techniques,

**Interaction Techniques:** Systems and Applications

**TEXT BOOKS:**

1. Intelligent Data Analysis, Michael Berthold, David J. Hand, Springer, 2007
2. Mining of Massive Datasets, Anand Rajaraman and Jeffrey David Ullman, Cambridge University Press, 2012

**REFERENCES:**

1. Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, Bill Franks, John Wiley & Sons, 2012
2. Big Data Glossary, Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, Pete Warden, O'Reilly, 2011
3. Data Mining Concepts and Techniques, Jiawei Han, Micheline Kamber, 2<sup>nd</sup> Edition, Elsevier, 2008

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**(A19OE1CS11) FUNDAMENTALS OF COMPUTER ALGORITHMS**

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To reinforce algorithms analysis methods
- To analyse running time of an algorithm
- To understand different algorithm design strategies
- To familiarize with an assortment of important algorithms

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Apply algorithm design techniques and concepts to solve given engineering problem

**CO-2:** Analyze running times of algorithms using asymptotic analysis

**CO-3:** Develop efficient algorithms for computational tasks

**CO-4:** Computing complexity measures of algorithms

**UNIT – I:**

**Introduction:** Characteristics of algorithm. Analysis of algorithms: Asymptotic analysis of complexity bounds – best, average and worst-case behaviour; Performance measurements of Algorithm, Time and space trade-offs.

**UNIT – II:**

**Divide and Conquer:** General method, applications-Binary search, Quick sort, Merge sort, Strassen's matrix multiplication. Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.

**UNIT – III:**

**Greedy Method:** General method, applications-Job sequencing with deadlines, 0/1 knapsack problem, Minimum cost spanning trees, Single source shortest path problem, Huffman Codes.

**UNIT – IV:**

**Dynamic Programming-I:** General method, Principle of optimality, applications-Multistage graphs, Matrix chain multiplication, Optimal binary search trees.

**UNIT – V:**

**Dynamic Programming-II:** 0/1 knapsack problem, All pairs shortest path problem, Travelling sales person problem, Reliability design.

**UNIT – VI:**

**Backtracking:** General method, applications- N-Queen problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles.

**TEXT BOOKS:**

1. Fundamentals of Computer Algorithms, E. Horowitz et al., Galgotia Publications
2. Introduction to Algorithms, Thomas H. Cormen, Charles E. Lieserson, Ronald L. Rivest and Clifford Stein, 4<sup>th</sup> Edition, MIT Press/McGraw-Hill

**REFERENCES:**

1. Algorithm Design, Jon Kleinberg and Eva Tardos, 1<sup>st</sup> Edition, Pearson
2. Algorithm Design: Foundations, Analysis and Internet Examples, Michael T. Goodrich and Roberto Tamassia, 2<sup>nd</sup> Edition, Wiley
3. Algorithms – A Creative Approach, Udi Manber, 3<sup>rd</sup> Edition, Addison-Wesley
4. Introduction to the Design and Analysis of Algorithms, Anany Levitin, 3<sup>rd</sup> Edition, Pearson

# GENERAL



## **PROFESSIONAL ETHICS AND HUMAN VALUES**

Ethics is a necessary and listed Graduate Attribute for all engineers according to the Washington Accord. As engineers deal with the society and provide for the society, it is important that the ethical concerns pertaining to technology are well-understood and addressed. Human Values form the basis for all Ethics and ethical theories help resolve professional dilemmas too. This course aims to create an appreciation for normative and applied ethics with special focus on professionalism and technology education and practice. Given the diverse set of roles an engineer or computer scientist may play in the society, there is an inherent societal need for engineers, technologists, and computer scientists to be ethical. The formative years of students of engineering are the best time to impress upon them the practical importance and application aspects of ethics. The curriculum is designed to include an inherent appreciation for the Indian Ethos and cover a wide variety of topics with suitable case studies and examples all through, so as to enable the learners to find practical contexts in global and contemporary careers of their future. The course also leads to attaining two other Graduate Attributes majorly, along with Ethics, viz. Engineer and Society, and Lifelong Learning.

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### (A19OE1HS01) PROFESSIONAL ETHICS AND HUMAN VALUES

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To emphasize on the importance of ethics for engineers and computer scientists
- To provide a toolkit for ethical behaviour in personal and professional settings
- To relate the profession of engineering to sociocultural as well as ethical and moral contexts in India and globally
- To develop more socially conscious engineers who create and conceive a better society and a better world without sacrificing or ignoring public good

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Distinguish morals, values, and ethics in Indian and global contexts

**CO-2:** Resolve moral and ethical dilemmas through ethical inquiries and appropriate ethical theories

**CO-3:** Realize the professional role of engineers in society and the support available in creating safe solutions for the society focusing on public welfare

**CO-4:** Conduct themselves ethically in various roles that present themselves in professional and business environments

**UNIT – I:**

**Motivation and Introduction to Human Values:** Motivation to study ethics in engineering with justifying case studies, historical events, and current affairs; Morals, Values, and Ethics – Definitions; Moral Judgement vs. Value Judgement; Moral Character and Moral Autonomy – Conscientiousness, Integrity, Empathy as basic building blocks; The Golden Rule; Maslow's Theory of Needs; Universal Human Values and Theories; Conventional and Constitutional Values in Indian Ethos; Anomie vs. Civic Virtue as a foundation for an ideal society; Ethics as a basis of legal framework; Privacy and Confidentiality – Increasing emphasis in personal and professional lives, technological considerations and examples; Profession, Professionalism – Definitions, Engineering as a Profession

**UNIT – II:**

**Ethics, Ethical Theories, and Professionalism:** Ethics through Spirituality, Religion, and beyond; Indian Philosophy and Ethos, ancient to modern – Family System, Ethical Pluralism, Unity in Diversity; Ethics as application of values and as moral philosophy – Kohlberg's theory vs. Gilligan's theory of moral development leading to ethics, examples; Moral and Ethical Dilemmas – Definition, Causes, Case Studies and Examples; Resolution of Ethical Dilemmas through Ethical Inquiries – Normative, Conceptual, and Factual Inquiries, Classification of Ethics by Character and

Conduct – Consequentialism/ Utilitarianism, Deontological Ethics, Virtue Ethics and Theories, Rights Theories; Ethical Frameworks and examples; Practical application of ethical theories for decision-making in personal life

#### **UNIT – III:**

**Professionalism, Engineering in the Societal Context:** Professionalism – Professional Traits, Rights, Responsibilities, Roles, Virtues; Business Ethics; Engineering as Social Experimentation – Context with examples, Comparison with standard experiments, Application of Ethical Inquiries to gain knowledge and to gather relevant information, Responsibility of Experimenters, Accountability and Answerability, Consensus and Need for Informed Consent – how to address exceptions; Responsible Innovation – Social Context of Innovation, Responsible Research and Innovation, Data Privacy and Protection of Individual Rights, being Ethical by Design; Trust in the context of professionalism – confidentiality, non-disclosure agreements (NDA); Intellectual Property (IP) – IP Rights (IPR) as Professional Rights, Law, Moral Rights and Economic Rights, Patenting; Diverse roles of Engineers as Professionals – Manager, Leader, Consultant, and Expert Witness

#### **UNIT – IV:**

**Professional Ethics, Ethics at Workplace and Roles of Engineers:** Overview of Organizational Behaviour; Collegiality, Loyalty, Trust in professional context; Respect for Authority vs. Moral Autonomy, Moral Responsibility; Organizational context of Ethics – Minor, interpersonal, severe, organizational workplace deviances; Occupational Crime, Culpable mistakes, Collateral damage; Gifts and bribes; Industrial Ethics for non-professionals; Code of ethics and Code of Conduct – Role of professional societies in guiding, promoting, and protecting professionals and professions, Examples of common professional societies in Engineering and Science; Decision-making in professional context – Choosing the right guidance, choosing the right ethical theory; Conflicts in profession and at workplace - Employee Relations and Discrimination, Conflict of Interest, Conflict Management and Resolution, Framework for Conflict Resolution; Multinational Companies and Corporates – Work Culture and Respect for Diversity and Pluralism; Employee Rights vs. Professional Rights; Whistleblowing – Social, Organizational, and Legal context with examples

#### **UNIT – V:**

**Public Welfare, Safety & Risk:** Impact of engineering activities and technology on Public Welfare; Ethical Concerns of Public welfare in the context of Emerging Technologies – Artificial Intelligence, Machine Learning, Internet of Things, Cybersecurity and Cybercrime; Issues of Public Concern – Informed Consent, Health and environmental aspects, data security; Safety and Risk – Definitions; Risk Assessment – Known and Unintended consequences, Risk-Benefit Analysis, Reducing Risk, Optimum Level of Safety, Capability Curves, Safe Exit; Learning from the Past – Case Studies in Ethics Context: Titanic, Bhopal, Chernobyl; Environmental Ethics and Sustainable Development Goals; Computer Ethics and various Technology Ethics; Ethics in the context of War and Weapon Development; Ethics and Economics – Fair

Trade, Capitalism vs. Communism, Developed vs. Developing vs. Underdeveloped economies

#### **UNIT – VI:**

**Ethics for Lifelong Learning:** Ethics in the context of Globalization; Moral Character and Ethical Leadership – Case Studies and Examples of success and failure; Overview and comparison of different schools of thought, comparison of the works of pioneering philosophers and social scientists – Immanuel Kant, John Rawls, Martin Heidegger, Swami Vivekananda, Jiddu Krishnamurti, Dr. Abdul Kalam, etc.; Impact of Ethical and Unethical Behaviour in personal and professional lives, developing and maintaining ethical behaviour, threats to moral autonomy and how to continue to be ethical in personal and professional lives

#### **TEXT BOOKS:**

1. Ethics in Engineering, Mike W. Martin, Roland Schinzinger, McGraw-Hill, 2017
2. Business Ethics: An Indian Perspective, A. C. Fernando, K. P. Muralidheeran, E. K. Satheesh, Pearson Education, 2019
3. Professional Ethics, R. Subramanian, Oxford University Press, 2017

#### **REFERENCES:**

1. Engineering Ethics: Concepts & Cases, Charles E. Harris, Jr., Michael S. Pritchard, Michael J. Rabins, Cengage Learning, 2012
2. Classical Indian Ethical Thought: A Philosophical Study of Hindu, Jaina and Bauddha Morals, Kedar Nath Tiwari, Motilal Banarsidass Publishers, 2017
3. The Manual for Indian Start-Ups, Dalai Lama, Ethics for the Whole World 978-9351360803 Vijay Kumar Ivaturi et al., Penguin Random House India, 2017
4. To Be Human, Jiddu Krishnamurti, Shambhala, 2000
5. On Ethics and Economics, Amartya Sen, Oxford India, 1999

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B.Tech. VI Semester

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(A19OE1HS02) ENTREPRENEURSHIP

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To motivate the engineers to inculcate the skills thereof in any professional role and to consider intrapreneurship or entrepreneurship as career choices for personal and societal growth
- To impart lean management principles and practices to plan, execute, and convert one's own idea into a sustainable business model
- To gain practical knowledge to design one's own lean startup
- To identify and avoid the potential pitfalls in validation, design, production, and marketing phases of an innovative product or service

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Discover societal problems as entrepreneurial opportunities and ideate to develop solutions through systematic and creative approaches to innovation and business strategy

**CO-2:** Apply lean methodology to startup ideas using Business Model Canvas and Lean Canvas and be able to create Business Plan

**CO-3:** Validate ideas, design, production, and marketing systematically using techniques such as 5 Whys, Innovation Accounting, Value and Growth Propositions

**CO-4:** To strategize during ideation, production, market research, marketing and facing competition

**UNIT – I:**

**Entrepreneurial Skills and Opportunities :** Role of Entrepreneurs in Indian and World Economy; Entrepreneurship as a career for engineers, scientists, and technologists; Personality and Skill Set of an Entrepreneur; Need for Ethics and Empathy for Entrepreneurs; Stories of Successful and Failed Enterprises; Current Business Trends; Entrepreneurial Management vs. Corporate Management – Roles and Scope; Concepts of Intrapreneurship, Social Entrepreneurship, Technopreneurship, Studentpreneurship; Opportunities in Telangana State and India – incubators, schemes, accelerators

**UNIT – II:**

**Introduction to Lean Startup Methodology:** Overview, Principles of Lean Startup, Lean vs. Traditional Startup; Vision-to-Steering, Start-Define-Learn-Experiment, Leap-Test-Measure-Pivot, Build-Measure-Learn

### **UNIT – III:**

**Business Model Concepts:** Components of Business Plan; Business Model Canvas (BMC); Lean Canvas (LC); Pitch Deck; Elevator Pitch; Financial Aspects – Financing, Funding Stages, Inflows, Outflows; Market Research and Marketing

### **UNIT – IV:**

**Building Your Business Model:** Desirability, Feasibility, and Viability; Minimum Viable Product (MVP), Proof of Concept (PoC), Prototype; Early Adopters; Value Proposition; Overview of opportunities in India – Financing and Support Schemes, Online and Offline Resources, Entrepreneurial Networks

### **UNIT – V:**

**Evaluating Your Business Model:** Three Learning Milestones of Innovation; Root Cause Analysis (RCA) through 5 Whys; Pivot or Persevere; The Engines of Growth: Sticky, Viral, and Paid; Kan-ban Diagram for Project Planning and Resource Allocation

### **UNIT – VI:**

**Strengthen Your Business Model:** Why startups fail? Value and Waste; Design Thinking for Business; Analogs and Antilogs; Paralysis by Analysis and Extinct by Instinct; The three A's: Actionable, Accessible, and Auditable Metrics and Vanity Metrics

### **TEXT BOOKS:**

1. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Eric Ries, Penguin Portfolio, 2015 (ISBN: 978-0670921607)
2. Entrepreneurship, Robert D. Hisrich, Michael P. Peters and Dean A. Shepherd, Tata McGraw-Hill, 11<sup>th</sup> Ed., 2020 (ISBN: 978-9390113316)
3. Entrepreneurship Simplified: From Idea to IPO, Ashok Soota, S R Gopalan, Penguin Random House India, 2016 (ISBN: 978-0670088959)

### **REFERENCES:**

1. Measure What Matters: OKRs: The Simple Idea that Drives 10x Growth, John Doerr, Penguin Portfolio, 2018 (ISBN: 978-0241348482)
2. Entrepreneurship Development and Business Ethics, Abhik Kumar Mukherjee, Shaunae Roy, Oxford University Press, 2019 (ISBN: 978-0A199494460)
3. The Manual for Indian Start-Ups, Vijay Kumar Ivaturi et al., Penguin Random House India, 2017 (ISBN: 978-0143428527)
4. Social Entrepreneurship in India: Quarter Idealism and a Pound of Pragmatism, Madhukar Shukla, SAGE Publications India Pvt Ltd, 2020 (ISBN: 978-9353882372)
5. Entrepreneurship: A South Asian perspective. Donald F Kuratko, T.V Rao. Cengage Learning, 2012

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**(A19OE1HS03) PERSONALITY DEVELOPMENT AND PUBLIC SPEAKING**

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To develop skills and techniques for Effective Communication and Public Speaking
- To develop Leadership qualities and increase Self – confidence
- To get along with people and Team-Building
- To enhance career opportunities by Goal setting
- To develop an acceptable PERSONALITY

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Communicate better and speak with confidence

**CO-2:** Exhibit Leadership qualities and increased Self – confidence

**CO-3:** Work towards Team-Building

**CO-4:** Use career opportunities by Goal setting

**CO-5:** Acquire a forceful personality to maintain a pleasant relationship between the seniors and subordinates and other stakeholders

**UNIT – I:**

**EFFECTIVE COMMUNICATION**

- i. Fundamentals of Effective Communication
- ii. How to sell your ideas
- iii. Communication within Industry (awareness of motivation, ego states, games, etc.)
- iv. Guidelines on: Listening, Reading and Writing
- v. Non-verbal Communication (Body Language)
- vi. Barriers of Communication

**UNIT – II:**

**PUBLIC SPEAKING (SPEECH COMMUNICATION)**

- i. How to develop courage and self-confidence
- ii. Speech purposes, preparation patterns and outlining of speech
- iii. Fundamentals and secrets of good delivery
- iv. How to make your meaning clear and convince an audience / client
- v. How to close effectively and get action?
- vi. How to participate in conferences, group discussions and office meetings

**UNIT – III:**

**PERSONALITY DEVELOPMENT - 1**

- i. Leadership - qualities of a successful leader ; Leadership Styles; Leadership in Administration; Problem-solving & Decision-making
- ii. Group Dynamics and Team Building

- iii. Importance of groups in organization; Interactions in group, Group Decision Taking, Team Building, Interaction with the Team, Building a good team

#### **UNIT – IV:**

##### **PERSONALITY DEVELOPMENT -2**

- i. Interpersonal Relations- Introduction; Transactional Analysis in communication Awareness of Ego states and their application in communication
- ii. Conflict Management- Introduction & Causes of Conflict; Managing Conflict

#### **UNIT – V:**

##### **PERSONALITY DEVELOPMENT -3**

- i. Positive Attitude & Ways to develop positive attitude  
Self Esteem & Confidence Building
- ii. Motivation- Importance of self-motivation;
- iii. Stress -Causes of Stress & Impact of Stress; Managing Stress

#### **UNIT – VI:**

##### **PERSONALITY DEVELOPMENT -4**

- i. Goal Setting-Meaning; Short, medium and Long Term Goals;  
Importance of Goal setting & Steps for Goal Setting
- ii. Creativity-Meaning; Barriers to Creativity & Steps to stimulate Creativity  
Understanding and Importance of Human Values; Ideals in Life; Becoming a Role Model
- iii. Time Management - Time as a Resource; Techniques for better Time Management.

#### **TEXT BOOKS:**

1. Advance Speaking Skills, Jeremy Harmer & John Arnold, Essex, Longman Group Limited, 1978
2. Developing Soft Skills, Sherfield R. M., Montgomery R. J., Moody P. G. 4<sup>th</sup> Edition, Pearson, 2010
3. Personality Development and Soft Skills, Barun K. Mitra, Oxford University Press, 2016

#### **REFERENCES:**

1. Body Language: A Guide for Professionals, Hedwig Lewis, Response Books (A Division of Sage Publications India), 1998
2. Emotional Intelligence, Daniel Goldman, Bantam Books, 1995
3. Personality Development, Rajiv Mishra, Rupa & Co., 2004



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(A19OE1HS04) FOREIGN LANGUAGE – FRENCH

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To communicate verbally in a simple way by asking and responding to simple questions related to everyday language needs
- To read and comprehend different kinds of texts (notices, informal letters, catalogues, menus etc.)
- To write clear, concise, and correct sentences and paragraphs on familiar topics.
- To recognize and use basic syntax and structures in French including articles, prepositions and connecting words as well as master basic vocabulary

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Use vocabulary contextually and effectively

**CO-2:** Use reading skills to comprehend different kinds of texts

**CO-3:** Understand everyday expressions dealing with simple and concrete everyday needs, in clear, slow and well-articulated speech and manage very short mini dialogues /conversations

**CO-4:** Demonstrate basic competence in Written French including grammar, sentence and paragraph structure, coherence

**UNIT – I: Introduce oneself and introduce someone:**

**Reading:** Read and understand an introduction about someone

**Grammar:** Question words, Subject verb agreement, Mas/fem and prepositions with cities and countries

**Vocabulary:** professions, nationalities, countries numbers, days of the week and verbs

**Writing:** Build basic sentences and Write about oneself

**Life Skills:** Greetings, Formal and Informal way of asking questions

**UNIT – II: Express likes and dislikes and Talk about your locality:**

**Reading:** Read and understand description of a place

**Grammar:** Articles, prepositions, possessive adjectives, basic connecting words such as “like, and, but”, and Negation

**Vocabulary:** Adjectives, verbs of preference, different places, and basic vocabulary on leisure and sports activities.

**Writing:** Write about hobbies and pastimes

**Life Skills:** Conversation fillers

**UNIT – III: Take / Fix an appointment with someone:**

**Reading:** Understand propositions and counters

**Grammar:** How to say time, Interrogative adjectives

**Vocabulary:** Irregular verbs, days of the week, Fixed expressions with Etre and Avoir and expressions to ask for appointment or refuse/accept a proposed time

**Life Skills:** Telephone etiquette and colloquial expressions in French

**UNIT – IV: Talk about your routine / Invite someone and Accept or refuse an invitation**

**Reading:** Read and understand an invitation on basic info: date and time, venue, occasion, type of invitation etc.

**Grammar:** Question word Why, Connecting word “because”, partitive and contracted articles, reflexive verbs

**Vocabulary:** Expressions to propose, thank / apologize and accept or refuse an invitation,

**Writing:** Respond to an invitation (Accept or refuse)

**Life Skills:** At the table

**UNIT – V: Ask for information (timings, price, etc) and Ask for/ Give Directions**

**Reading:** Understand signboards and instructions

**Grammar:** Imperative mode and prepositions.

**Vocabulary:** Directions, Expressions to ask information or seek precision

**Writing:** Give instructions and fill a form

**UNIT – VI: Vacation (plan vacation, choose destination, visit, and appreciate)**

**Reading:** Read and understand travel brochures for basic info on offers, locations, touristic attractions hotels and so on

**Grammar:** demonstrative adjectives and near future tense

**Vocabulary:** Weather forecast, modes of transport, and vacation activities

**Writing:** Write a post card

**Life Skills:** Types of vacation in France

**TEXT BOOKS:**

1. Painless French, Carol Chitin, Lynn Gore, Barrons Educational Series, 2016 (ISBN: 978-1438007700)
2. Language Learning University, French: Learn French for Beginners Including French Grammar, French Short Stories and 1000+ French Phrases, Createspace Independent Publications, 2018 (ISBN: 978-1726415002)
3. Language School, French Language for Beginners, 2019 (ISBN: 978-1700175700)

**REFERENCES:**

1. Practice Makes Perfect: Complete French All-in-One, Annie Heminway, McGraw-Hill Education, 2018 (ISBN: 978-1260121032)
2. Easy French Step-by-Step, Myrna Bell Rochester, McGraw-Hill Education, 2008 (ISBN: 978-0071453875)

3. Contacts: Langue et culture françaises, Jean-Paul Valette, Rebecca Valette, Wadsworth Publishing Co. Inc., 2012 (ISBN: 978-1133309581)

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(A19OE1CE09) SMART CITIES

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To understand smart city basic concepts, global standards, and Indian context of smart cities
- To explain smart community, smart transportation and smart buildings
- To understand Energy demand, Green approach to meet Energy demand and their capacities
- To identify Smart Transportation Technologies in cities and concepts towards smart city

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Explain and elaborate smart city concepts and their international and national standards

**CO-2:** Conceptualize smart community, transportation and building concepts

**CO-3:** Develop and calibrate energy demand and their capacity limits

**CO-4:** Predict the various smart urban transportation systems and the transition from existing city towards a smart city

**UNIT – I:**

**Introduction to Smart Cities:** Introduction to Smart Cities - Understanding Smart Cities -Dimensions of Smart Cities – World urbanization, Global Experience of Smart Cities, Smart City case studies-Indian scenario - India “100 Smart Cities” Policy and Mission.

**UNIT – II:**

**City as a System of Systems:** Systems thinking – Developing a smart city approach – Core elements of a smart city – Relevant open data for a smart city – Sustainability – Privacy and Ethics – Energy systems for smarter cities.

**UNIT – III**

**Smart Cities Planning and Development:** Introduction to Smart Community; Smart community concepts: Concept of Smart Community - Smart Transportation - Smart Building and Home Device - Smart Health - Smart Government - Smart Energy and Water - Cybersecurity, Safety, and Privacy; Internet of Things, Blockchain, Artificial Intelligence, Alternate Reality, Virtual Reality.

**UNIT – IV:**

**Smart Urban Energy Systems:** Conventional vs. Smart, City components, Energy demand, Green approach to meet Energy demand, Index of Indian cities towards

smartness – a statistical analysis -Meeting energy demand through direct and indirect solar resources- Efficiency of indirect solar resources and its utility, Capacity limit for the indirect solar resources- Effectiveness in responsive environment in smart city; Smart communication using green resources- **Relevant case studies**

#### **UNIT – V:**

**Smart Transportation Systems:** Smart Transportation Technologies - Driverless and connected vehicles - ride sharing solutions - The "improve" pathway - The "shift" pathway – Smart Roads and Pavement systems – Relevant case studies

#### **UNIT – VI:**

**Future of Smart Cities:** The transition of legacy cities to Smart - Right transition process - the benefit of citizens, cities have to adopt effective management and governance approaches-factors in the transition phase of legacy cities to Smart cities and their managerial implications.

#### **TEXT BOOKS:**

1. Internet of Things in Smart Technologies for Sustainable Urban Development, G. R. Kanagachidambaresan, R. Maheswar, V. Manikandan, K. Ramakrishnan., Springer, 2020
2. Society 5.0: A People-Centric Super-Smart Society, Hitachi-U Tokyo Laboratory (H-U Tokyo Lab), Springer, 2020
3. The Routledge Companion to Smart Cities, Katharine S. Willis, Alessandro Aurigi, Routledge International Handbooks, 2020

#### **REFERENCES:**

1. Smart Cities in Asia: Governing Development in the Era of Hyper-Connectivity Yu-min Joo, Yu-Min Joo, Teck-Boon Tan, Edward Elgar, 2020
2. Urban Systems Design: Creating Sustainable Smart Cities in the Internet of Things Era, Yoshiki Yamagata, Perry P. J. Yang, Elsevier, 2020
3. Smart Cities and Artificial Intelligence: Convergent Systems for Planning, Design, and Operations, Christopher Grant Kirwan, Zhiyong Fu, Elsevier, 2020

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**(A19OE1EE05) TRENDS IN ENERGY SOURCES FOR SUSTAINABLE DEVELOPMENT**

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To understand the role of sustainable energy
- To know components of solar PV and wind energy conversion systems
- To understand the principles of Biomass, geo-thermal and wave energy systems
- To learn various energy storage methods

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand various sources for sustainable energy

**CO-2:** Understand Solar Photo voltaic and wind energy systems

**CO-3:** Learnt the harnessing techniques of Biomass, geothermal and ocean energy

**CO-4:** Familiarize with energy storage methods

**UNIT – I:**

**Introduction:** Trends in energy consumption - Conventional and renewable sources, Energy sources and their availability, Energy Conservation status in India -need of new energies for sustainable development.

**UNIT – II:**

**Fundamentals of Solar Radiation:** Introduction-The Sun as Source of Energy, Extraterrestrial and Terrestrial Radiations, Spectral Power Distribution of Solar Radiation, instruments for measuring solar radiation and sunshine recorder.

**Solar PV Conversion:** The PV Cell-Crystalline Solar cells -Thin film and amorphous solar cells, Module, Array, Equivalent Electrical circuit- Open circuit voltage and Short circuit current, I-V, P-V Curves. Developments in efficient non silicon solar cells

**UNIT – III:**

**Wind Energy:** origin of winds-Global (or Planetary) Winds- Local Winds-Factors Affecting the Distribution of Wind Energy on the Surface of Earth, Wind Turbine – Types, construction of HAWT, VAWT, performance characteristics, Betz criteria.

**UNIT – IV:**

**Bio-Mass:** Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Biogas digesters, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation and economic aspects.

**UNIT – V:**

**Geothermal Energy:** Resources, types of wells, methods of harnessing the energy

**Ocean Energy:** OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles.

**Tidal and Wave Energy:** Potential and conversion techniques, mini-hydel power plants, and their economics.

#### **UNIT – VI:**

##### **Energy Storage:**

**Electro Chemical Storage:** lead-acid- nickel cadmium-nickel-metal-hydride and lithium type batteries-Principle of operation, Types, Advantages and disadvantages.

**Non-Electric Storage:** Methods of Energy storage –Pumped Energy Storage – Compressed air Energy Storage, Superconducting Magnet Energy Storage.

##### **TEXT BOOKS:**

1. Non-Conventional Energy Sources, G. D. Rai, 6<sup>th</sup> Edition, Khanna Publishers, 2004
2. Non-Convention Energy Resources, B. H. Khan, 3<sup>rd</sup> Edition, McGraw-Hill, 2017

##### **REFERENCES:**

1. Renewable Energy Sources, Twidell & Weir, 3<sup>rd</sup> Edition, CRC Press, 2015
2. Solar Energy, Sukhatme, 3<sup>rd</sup> Edition, McGraw-Hill, 2008
3. Non-Conventional Energy, Ashok V. Desai, Wiley Eastern, 1990

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**(A19OE1ME05) 3D PRINTING AND DESIGN**

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To understand the need and know about the applications of 3D Printing
- To understand the need of liquid and solid based 3D Printing systems
- To know about the laser-based 3D Printing systems and importance of CAD for 3D Printing
- To understand post-processing, inspection and testing involved in 3D Printing

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Summarize the importance of 3D Printing

**CO-2:** Explain the process involved in liquid and solid based 3D Printing Systems

**CO-3:** Explain about the laser-based 3D Printing systems and CAD for 3D Printing

**CO-4:** Plan post-processing techniques and perform inspection and testing in 3D Printing

**UNIT – I:**

**Introduction:** Introduction to 3D Printing, Classification, 3D Printing Process Chain, Materials for 3D Printing, Distinction between 3D Printing & Conventional Manufacturing.

**Applications:** Brief overview of applications in Aerospace, Automotive, Biomedical, Defense, Construction, Jewelry, Coin and Tableware Industry.

**UNIT – II:**

**Liquid Based 3D Printing Systems:** Introduction, Principle, Processes and Applications of Material Jetting and Stereolithography.

**UNIT – III:**

**Solid Based 3D Printing Systems:** Introduction, Principle, Processes and Applications of Fused Deposition Modeling (FDM) and Laminated Object Manufacturing (LOM).

**UNIT – IV:**

**Powder Based 3D Printing Systems:** Introduction, Principle, Processes and Applications of Selective Laser Sintering (SLS), Three-Dimensional Printing (3DP).

**UNIT – V:**

**CAD for 3D Printing:** CAD data formats, CAD model preparation, Part orientation and support generation, Overview of 3D Printing softwares like MAGICS and MIMICS only.



**UNIT – VI:**

**Post Processing:** Introduction, Post Processing Techniques like Support material removal, Cleaning, Sanding and Polishing.

**Inspection:** Introduction, Significance, Inspection techniques like Dimensional measurement along X, Y and Z axes, visual inspection of the surface finish (overall aesthetics and intact features), flatness or warp check, and FOD (foreign objects or debris) check.

**TEXT BOOKS:**

1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Ian Gibson, David W. Rosen, Brent Stucker, Springer, 2010
2. Rapid Prototyping: Principles and Applications, Chua C. K., Leong K. F., and Lim C. S., 3<sup>rd</sup> Edition, World Scientific, 2010

**REFERENCES:**

1. Rapid Prototyping and Engineering Applications: A Toolbox for Prototype Development, Liou L. W. and Liou F. W., CRC Press, 2007
2. Rapid Prototyping: Theory and Practice, Kamrani A. K. and Nasr E. A., Springer, 2006
3. Rapid Tooling: Technologies and Industrial Applications, Hilton P. D. and Jacobs P. F., CRC Press, 2000
4. Rapid Prototyping, Gebhardt A., Hanser, Gardener Publications, 2003

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**(A19OE1EC09) EMBEDDED SYSTEMS FOR IOT**

**COURSE PRE-REQUISITES:** Programming through C

**COURSE OBJECTIVES:**

- To understand the basics of computing with embedded systems
- To expose the students to various smart sensors
- To make the students familiar with the programming concepts of embedded development board
- To understand the basics of Internet of Things and cloud of things

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Familiar with architectural and programming issues of embedded systems

**CO-2:** Able to select proper smart sensor for a specific measurement application

**CO-3:** Analyze various protocols for Internet of Things

**CO-4:** Apply Internet of Things to different applications in the real world

**UNIT – I:**

**Embedded System Design:** Numbering and Coding Systems, Digital Premier, Inside the Computer

Embedded System - Definition, Characteristics of embedded computing applications, Design challenges, Requirements, Specification, Architecture design, Designing hardware and software components, system integration.

**UNIT – II:**

**Smart Sensors & Applications:** Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, the Automation.

**UNIT – III:**

**Sensors Applications:** Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing, Sensors for environmental Monitoring.

**UNIT – IV:**

**Micro Controller Board:** Features of Arduino, Arduino components and IDE, Interfacing: Seven Segment Display, Pulse Width Modulation, Analog Digital Converter, Wireless connectivity to Arduino. Case study: From BT To WiFi: Creating WiFi Controlled Arduino Robot Car.

**UNIT – V:**

**Introduction to Internet of Things:** Definition and Characteristics of IoT, Physical Design of IoT, Logical Design of IoT, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Deployment Templates, M2M, IoT vs M2M.

**UNIT – VI:**

**Domain Specific Applications of IoT:** IoT Design Methodology, Applications of IoT– Home, Health, Environment, Energy, Agriculture, Industry and Smart City.

**TEXT BOOKS:**

1. The 8051 Microcontroller: Programming, Architecture, Ayala & Gadre, 3<sup>rd</sup> Edition, Cengage Publications, 2008
2. Sensors and Transducers, D. Patranabis, 2<sup>nd</sup> Edition, PHI Learning Private Limited, 2013
3. Internet of Things: A Hands-On Approach, Vijay Madiseti, Arshdeep Bahga, Universities Press, 2015

**REFERENCES:**

1. Embedded Systems: Architecture, Programming and Design, 2<sup>nd</sup> Edition, TMH
2. The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, 2<sup>nd</sup> Edition, 2005
3. Internet of Things with Raspberry Pi and Arduino, Singh R., Gehlot A., Gupta L., Singh B., Swain M., Boca Raton, CRC Press, 2020

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(A19OE1CS09) ARTIFICIAL INTELLIGENCE – A BEGINNER'S GUIDE

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To understand and analyze the basic concepts of artificial intelligence
- To identify, explore the complex problem-solving strategies and approaches
- To analyze the concepts of basic concepts of neural networks and learning process
- To explore and analyze the methodology used in machine learning and computer vision

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand and apply the basic concepts of artificial intelligence and its use cases. lives

**CO-2:** Explore the various search strategies and approaches for problem solving

**CO-3:** Correlate the fields related to AI, and articulate various learning paradigms

**CO-4:** Describe several issues and ethical concerns surrounding AI

**UNIT – I:**

**Introduction to AI:** What is AI-On Overview, History of AI, Applications and Examples of AI, AI Concepts, Terminology, Key fields of AI. AI Issues, Concerns, and Ethical Considerations.

**UNIT – II:**

**AI as Search Process:** On overview of Search Strategy. Types of Searches- Uninformed, Informed, Bidirectional search, Heuristic search. Local search, Local beam search, Adversarial Search.

**UNIT – III:**

**AI as Knowledge Exploration:** Introduction to Propositional Logic, Rules of Inference, First Order Logic (FOL) Syntax, Semantics, Entailment, Tools to represent knowledge.

**UNIT – IV:**

**AI as a Learning Task:** Introduction to Learning, Learning types -Supervised, Unsupervised, Reinforcement Learning, Machine learning, Deep Learning, The link between AI, ML, DL.

**UNIT – V:**

**AI as Neural Networks:** Introduction to biological neural networks. Link between biological neuron and artificial neuron. Architecture of artificial neural network, Types of Neural networks-single layer, multilayer, Back propagation networks.

**UNIT – VI:**

**The future of AI:** Computer Vision - Seeing the World Through AI, Bots - Conversation as a Platform, AI and the society, AI in action-the Use Cases, Building AI Projects.

**TEXT BOOKS:**

1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, 3<sup>rd</sup> Edition, Prentice Hall, 2010
2. Machine Learning, Tom M. Mitchell, McGraw Hill
3. Neural Networks-A Comprehensive Foundation, Simon Haykin, 2<sup>nd</sup> Edition, Pearson Education, 2004

**REFERENCES:**

1. Artificial Intelligence, Elaine Rich & Kevin Knight, 2<sup>nd</sup> Edition, TMH
2. Artificial Intelligence- A New Synthesis, Nils J. Nilsson, Elsevier
3. Artificial Neural Networks, Yegnanarayana B., PHI

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(A19OE1CS10) BLOCKCHAIN TECHNOLOGY ESSENTIALS

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To introduce and get the technological overview of blockchain technologies
- To study the foundation of Blockchain Technology and demonstrate the various types of Blockchain
- To explore the application area of Blockchain Technology
- To introduce smart contract, consensus algorithm and security mechanism
- To introduce available platforms for implementing Blockchain Technology

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand and explore the Blockchain Technology

**CO-2:** Describe smart contract concepts

**CO-3:** Explore different types of Blockchain

**CO-4:** Develop the platforms to implement Blockchain Technology

**UNIT – I:**

**Fundamental of Blockchain Part I:** Introduction to Centralized, Decentralized and Distributed system, computer network peer to peer connection

**Fundamental of Blockchain Part II:** History of Blockchain, Various technical definitions of Blockchain. Generic elements of a blockchain: Block, Transaction, Node, Why It's Called "Blockchain", Characteristics of Blockchain Technology, Advantages of blockchain technology, Limitations of blockchain as a technology

**UNIT – II:**

**Concept of Blockchain Technology Part I:** Applications of blockchain technology, Tiers of blockchain technology Blockchain 0, Blockchain 1, Blockchain 2, Blockchain 3, Generation of Blockchain X, smart contract

**Concept of Blockchain Technology Part II:** Types of blockchain: Public blockchain, private blockchain, hybrid blockchain, examples of Public, private, hybrid blockchain and its merit and demerit.

**UNIT – III:**

**Technical Foundations Part I:** Component of block, Structure of Block chain, Technical Characteristics of the Blockchain, genesis block, Nonce

**Technical Foundations Part II:** Cryptography, Hashing, Distributed database, Consensus mechanisms, and basic of Cryptographic primitives, Technical Characteristics of Secure Hash Algorithms (SHA), Digital signature.

#### **UNIT – IV:**

**Consensus Algorithm:** Proof of work (PoW), Proof-of-Stake (PoS), Byzantine Fault Tolerance (BFT), Proof of authority (PoA), Confidentiality, Integrity, Authentication, Permissioned ledger, Distributed ledger, Shared ledger, Fully private and proprietary blockchains, Tokenized blockchains, Tokenless blockchains, CAP theorem and blockchain

#### **UNIT – V:**

E-Governance and other contract enforcement mechanisms, Financial markets and trading, Trading, Exchanges, Trade life cycle, Order anticipators, Market manipulation.

**Crypto Currency:** Bitcoin, Bitcoin definition, Keys and addresses, Public keys in Bitcoin, Private keys in Bitcoin, Bitcoin currency units

#### **UNIT – VI:**

**Implementation Platforms:** Hyperledger as a protocol, Reference architecture, Hyperledger Fabric, Transaction Flow, Hyperledger Fabric Details, Fabric Membership, Fabric Membership

#### **TEXT BOOKS:**

1. Mastering Blockchain, Imaran Bashir, 2<sup>nd</sup> Edition, Packt
2. Blockchain Basic, Daniel Drescher, A Press

#### **REFERENCES:**

1. Blockchain For Dummies®, IBM Limited Edition, John Wiley & Sons

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(A19OE1EI05) FUNDAMENTALS OF ROBOTICS AND DRONES

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To classification by coordinate system and control system
- To acquire knowledge on different types power sources and sensors
- To classify different types of manipulators, actuators and grippers
- To acquire knowledge on kinematics and vision systems used for different robots
- To acquire knowledge on the basics of drones

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Acquire knowledge on different types of Power Sources (actuators) and sensors, manipulators, actuators and grippers

**CO-2:** Acquire knowledge on different applications of various types of robots

**CO-3:** Analyze the direct and the inverse kinematic problems and calculate the manipulator dynamics

**CO-4:** Acquire knowledge on the applications of machine vision in robotics

**CO-5:** Acquire Knowledge on the basics of drones

**UNIT – I:**

**Basic Concepts & Fundamentals:** An overview of Robotics, classification of Robots, Robot Components, Robot degrees of freedom, Robot Joints, Robot Coordinates, Robot reference frames, Programming modes, Robot Characteristics.

**UNIT – II:**

**Sensors and Actuators:**

**Sensors:** Sensors characteristics, Position sensors, velocity sensors, acceleration sensors, torque sensors, micro switches, lighten infrared sensors, touch and tactile sensors, proximity sensors, range finders.

**Actuators:** Characteristics of activating system, comparison of activating system Hydraulic devices, Pneumatic devices, electric motors, magneto-strictive actuators.

**UNIT – III:**

**Manipulators and Grippers:**

**Grippers:** Robot end effectors, Classification, drive system for Gripper, Mechanical Grippers, Magnetic Grippers, Vacuum Grippers, Adhesive Grippers, Hooks, Scoops and other Miscellaneous Devices, Gripper force Analysis and Gripper Design, Active and passive Grippers.



**UNIT – IV:**

**Kinematics:** Matrix representation of translational and Rotational motion – Homogeneous Transformation-DH representation of standard configuration Robots-Inverse Kinematics. Joint space vs. Cartesian space-Basics of Trajectory planning in joint and Cartesian space.

**UNIT – V:**

**Robot Vision:** Low level and High-level vision

Image acquisition, Illumination Techniques, Imaging Geometry, Some Basic Relationships between Pixels, Segmentation, Description, Segmentation and Description of 3-D Structures, Recognition, Interpretation.

**UNIT – VI:**

**Basics of Drones:** Theory behind how drones work, individual components that makeup a drone, basic concepts involved radio-controlled model flying, building a complete quad copter drone from scratch

**TEXT BOOKS:**

1. Introduction To Robotics: Analysis, Control, Applications, Saeed B. Niku, 2<sup>nd</sup> Edition, Wiley
2. Industrial Robotics, Technology Programming and Applications, Mikell P. Groover, Nicholas G. Odrey, Mitchel Weiss, Roger N. Nagel, Ashish Dutta, McGraw-Hill, 2012

**REFERENCES:**

1. Robotics Technology and Flexible Automation, Deb S. R., John Wiley
2. Robots and Manufacturing Automation, Asfahl C. R, John Wiley
3. Robotic Engineering–An Integrated Approach, Klaffer R. D., Chimielewski T. A., Negin M., Prentice Hall of India
4. Drones for Beginners, Udemy

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**(A19OE1IT08) FUNDAMENTALS OF CYBER SECURITY**

**COURSE PRE-REQUISITES:** Basic Knowledge of Computers, Basic Knowledge of Networking and Internet

**COURSE OBJECTIVES:**

- To identify the key components of cyber security in network
- To describe the techniques in protecting Information security
- To define types of analyzing and monitoring potential threats and attacks
- To access additional external resources to supplement knowledge of cyber forensics and laws

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand, appreciate, employ, design and implement appropriate security technologies

**CO-2:** Demonstrate policies to protect computers and digital information

**CO-3:** Identify & Evaluate Information Security threats and vulnerabilities in Information Systems

**CO-4:** Understand computer forensics and analyzing them

**UNIT – I:**

**Introduction to Cyber Security:** Cybersecurity objectives, Cybersecurity roles, Differences between Information Security & Cybersecurity, Cybersecurity Principles - Confidentiality, integrity, & availability, Authentication & nonrepudiation, The Trinity of IT Security (CIA), Computer Protocols, Cookies, The TCP/IP

**UNIT – II:**

**Who are the Cyber Criminals:** Classification of cybercrimes, E-mail Spoofing, Spamming, Cyber defamation, Internet Time Theft, Salami Attack/ Salami Technique, Data Diddling, Forgery, Web Jacking, Newsgroup Spam/ Crimes Emanating from Usenet Newsgroup, Industrial Spying/Industrial Espionage, Hacking, Online Frauds, Pornographic Offenses, Software Piracy, Computer Sabotage, E-mail Bombing/Mail Bombs, UseNet Newsgroup as the Source of Cybercrimes, Computer Network Intrusions, Password Sniffing, Credit Card Frauds, Identity Theft.

**UNIT – III:**

**Cyber Offenses: How Criminals Plan Them:** Introduction, Categories of Cybercrime, How Criminals Plan the Attacks, Reconnaissance, Passive Attacks, Active Attacks, Scamming and Scrutinizing Gathered Information, Attack (Gaining and Maintaining the System Access), Social Engineering, Classification of Social Engineering, Cyber stalking, Types of Stalkers, Cases Reported on Cyber stalking, How Stalking Works?,

Real-Life Incident of Cyber stalking, Cyber cafe and Cybercrimes,

#### **UNIT – IV:**

**Security Threats:** Introduction to security threats-Virus, Worms, Trojan horse, Bombs, Trap Door, E-Mail Virus, Virus Life cycle, How virus works?, Malware, Network and Services attack- Dos attacks, Types of Dos attacks, Methods of attacks, Examples of attacks-SYN flooding, TCP flooding, UDP flooding, ICMP flooding, Smurf, Ping of death, Tear drop, Security threats to E-commerce-Electronic payment system, Credit card/Debit cards, Smart cards, E- money, Electronic Fund Transfer, E-commerce security System, Electronic Cash, Digital Signatures

#### **UNIT – V:**

**Introduction to Computer Forensics:** computer crimes, evidence, extraction, preservation, etc. Overview of hardware and operating systems: structure of storage media/devices; windows/Macintosh/ Linux -- registry, boot process, file systems, file metadata. Data recovery: identifying hidden data, Encryption/Decryption, Steganography, recovering deleted files. Digital evidence controls: uncovering attacks that evade detection by Event Viewer, Task Manager, and other Windows GUI tools, data acquisition, disk imaging, recovering swap files, temporary & cache files, Computer Forensic tools, Network Forensic.

**Computer Crime and Legal Issues:** Intellectual property, privacy issues, Criminal Justice system for forensic, audit/investigative situations and digital crime scene, investigative procedure/standards for extraction, preservation, and deposition of legal evidence in a court of law.

#### **UNIT – VI:**

**Fundamentals of Cyber law:** Evolution of the IT Act, Genesis and Necessity, Salient features of the IT Act, 2000, various authorities under IT Act and their powers, Penalties & Offences, amendments, Impact on other related Acts Cyber Space Jurisdiction - Jurisdiction issues under IT Act, 2000- Traditional principals of Jurisdiction - Extra-terrestrial Jurisdiction- Case Laws on Cyber Space Jurisdiction Sensitive Personal Data or Information (SPDI) in Cyber Law (a) SPDI Definition and Reasonable Security Practices in India (b) Reasonable Security Practices – International perspective

#### **TEXT BOOKS:**

1. Cyber Security- Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunit Belpure, Wiley
2. Fundamentals of Cyber Security, Mayank Bhusan, Rajkumar Singh Rathore, Aatif Jamshed, BPB Publications
3. Cyber Law & Cyber Crimes, Advocat Prashant Mali, Snow White Publications,

#### **REFERENCES:**

1. Computer Forensics and Cyber Crime: An Introduction, Marjie T. Britz, 3<sup>rd</sup> Edition, 2013

2. Digital Forensics with Open-Source Tools. Cory Altheide and Harlan Carvey, Elsevier, 2011
3. Network Forensics: Tracking Hackers Through Cyberspace, Sherri Davidoff, Jonathan Ham Prentice Hall, 2012
4. Cyber Law in India, Farooq Ahmad, Pioneer Books
5. Information Technology Law and Practice, Vakul Sharma, Universal Law Publishing Co.

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**(A19OE1IT09) FUNDAMENTALS OF DATA SCIENCE**

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To learn concepts, techniques and tools they need to deal with various facets of data science practice, including data collection and integration
- To exploring data analysis, predictive modeling, descriptive modeling, data product creation, evaluation, and effective communication
- To understand the basic knowledge of algorithms and reasonable programming experience and some familiarity with basic linear algebra and basic probability and statistics
- To identify the importance of recommendation systems and data visualization techniques

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand basic terms what Statistical Inference means. Identify probability distributions commonly used as foundations for statistical modeling. Fit a model to data

**CO-2:** Discuss the significance of exploratory data analysis (EDA) in data science and to apply basic tools (plots, graphs, summary statistics) to carry out EDA

**CO-3:** Apply basic machine learning algorithms and to identify common approaches used for Feature Generation

**CO-4:** Analyze fundamental mathematical and algorithmic ingredients that constitute a Recommendation Engine and to Build their own recommendation system using existing components

**UNIT – I:**

**Introduction:** What is Data Science? - Big Data and Data Science hype – and getting past the hype - Why now? – Datafication - Current landscape of perspectives - Skill sets needed - Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model - Intro to R

**UNIT – II:**

**Exploratory Data Analysis and the Data Science Process:** Basic tools (plots, graphs and summary statistics) of EDA - Philosophy of EDA - The Data Science Process - Case Study: Real Direct (online real estate firm) - Three Basic Machine Learning Algorithms-Linear Regression - k-Nearest Neighbors (k-NN) - k-means

**UNIT – III:**

One More Machine Learning Algorithm and Usage in Applications - Motivating

application: Filtering Spam - Why Linear Regression and k-NN are poor choices for Filtering Spam - Naive Bayes and why it works for Filtering Spam

#### **UNIT – IV:**

**Data Wrangling:** APIs and other tools for scrapping the Web - Feature Generation and Feature Selection (Extracting Meaning From Data) - Motivating application: user (customer) retention - Feature Generation (brainstorming, role of domain expertise, and place for imagination) - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests

#### **UNIT – V:**

**Recommendation Systems:** Building a User-Facing Data Product - Algorithmic ingredients of a Recommendation Engine - Dimensionality Reduction - Singular Value Decomposition - Principal Component Analysis - Exercise: build your own recommendation system - Mining Social-Network Graphs - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighbourhood properties in graphs

#### **UNIT – VI:**

**Data Visualization:** Basic principles, ideas and tools for data visualization 3 - Examples of inspiring (industry) projects - Exercise: create your own visualization of a complex dataset - Data Science and Ethical Issues - Discussions on privacy, security, ethics - A look back at Data Science - Next-generation data scientists

#### **TEXT BOOKS:**

1. Doing Data Science, Straight Talk From The Frontline. Cathy O’Neil and Rachel Schutt, O’Reilly, 2014
2. Mining of Massive Datasets v2.1, Jure Leskovek, Anand Rajaraman and Jeffrey Ullman, Cambridge University Press, 2014
3. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, 2013

#### **REFERENCES:**

1. Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani and Jerome Friedman, 2<sup>nd</sup> Edition, 2009
2. Foundations of Data Science, Avrim Blum, John Hopcroft and Ravindran Kannan
3. Data Mining and Analysis: Fundamental Concepts and Algorithms, Mohammed J. Zaki and Wagner Miera Jr. Cambridge University Press, 2014
4. Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber and Jian Pei, 3<sup>rd</sup> Edition, 2011

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**(A19OE1AE05) INTRODUCTION TO ADVANCED VEHICLE TECHNOLOGIES**

**COURSE PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

- To understand the layout of an automobile and functionalities chassis elements
- To provide the concepts of automotive electrical systems and electric & hybrid vehicles
- To present various intelligent automotive systems and levels of vehicle autonomy

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Explain the functionalities of automotive systems and subsystems

**CO-2:** Discuss the concepts of automotive electrical systems and electric & hybrid vehicles

**CO-3:** Describe various intelligent automotive systems and levels of vehicle autonomy

**UNIT – I:**

**Introduction:** Classification of automobiles, layout of an automobile and types of bodies.

**Automotive Chassis:** Introduction to chassis systems - engine, cooling, lubrication, fuel feed, ignition, electrical, driveline - clutch, transmission, propeller shaft, differential, axles, wheels and tyres, steering, suspension and braking.

**UNIT – II:**

**Engine:** Working principle of four stroke and two stroke SI and CI engines, fuel system – layout of petrol and diesel fuel systems, electronic fuel injection - multi-point fuel injection, gasoline direct injection, common rail direct injection.

**UNIT – III:**

**Electrical System:** Simple automotive wiring diagram and components of electrical system, starting system – starter circuit, standard Bendix and over running clutch drive, charging system – alternator, cut-outs and regulators, ignition system - conventional and electronic ignition system.

**UNIT – IV:**

**Electric and Hybrid Vehicles:** Electric vehicle – Layout, components, configurations, advantages and limitations. Hybrid vehicle - Concepts of hybrid electric drivetrain based on hybridization and powertrain configuration, architecture of series, parallel and series-parallel hybrid electric drivetrains, modes of operation, merits and demerits.

#### **UNIT – V:**

**Intelligent Vehicle Systems:** Automotive navigation, night vision, head-up display, airbag, seat belt tightening system, immobilizers, adaptive cruise control, forward collision warning, lane departure warning and anti-lock braking system.

#### **UNIT – VI:**

**Autonomous Vehicles:** Levels of automation, research, challenges, commercial development, sensor systems, sensor suits, environmental challenges, graceful degradation, V2V and V2I communication, sharing the drive, integrity, security, verification and policy implications.

#### **TEXT BOOKS:**

1. Advanced Vehicle Technology, Heinz Heisler, Butterworth Heinemann, 2002
2. Intelligent Vehicle Technologies: Theory and Applications, Ljubo Vlacic, Michel Parent and Fumio Harashima, Butterworth-Heinemann, Oxford, 2001
3. Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, CRS Press, 2004

#### **REFERENCES:**

1. Automotive Mechanics, Giri N. K., Khanna Publications, 2006
2. Automotive Electrical Equipment, Kohli P. L., Tata McGraw-Hill, 1975
3. Electric and Hybrid Vehicles – Design Fundamentals, Iqbal Husain, CRC Press, 2010
4. Autonomous Vehicle Technology-A Guide for Policymakers, James M. Anderson, Nidhi Kalra, Karlyn D. Stanley, Paul Sorensen, Constantine Samaras, Oluwatobi A. Oluwatola, RAND Corporation, 2016



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**(A19OE1CS12) INTRODUCTION TO APPLICATION DEVELOPMENT WITH C#**

**COURSE OBJECTIVES:**

- To create an integrated development environment for object-oriented C# programs
- To build website menus with CSS and JavaScript
- To relate programming language constructs and problem solving techniques
- To analyze and apply modifications to C# programs that solve real-world problems

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand the fundamentals of HTML5 and define the styles for web pages using CSS

**CO-2:** Create web pages and add dynamic behavior to web pages using Javascript

**CO-3:** Communicate with the database using SQL

**CO-4:** Develop a simple CUI [Character User Interface] based application using C# & SQL

**UNIT – I:**

**Computer, Software Engineering Fundamentals & OOP:** Introduction to Computer Basics, Basics of Network, Networking Levels and Layers and Protocols, Protocol Stacks, Networking and Internet Service, Software Engineering Fundamentals - Overview of Requirement Analysis, Overview of Software Design, Overview of Software Implementation, Overview of Testing, Overview of Software Maintenance, Overview of Configuration management and version Control, Agile Basics, OOP - Object Oriented Concepts, Objects and Classes, Principles in Object-Oriented technology

**Use case:** Create a class for Bank Account

**UNIT – II:**

**HTML & CSS:** Introduction to Web Technology, Introduction to HTML5, HTML5 Elements, Semantic Elements, Table, List, Working with Links, Image Handling, Form-Input Elements, HTML5 Form elements, HTML5 Attributes, Video & Audio, iframes, CSS - Introduction to CSS3, CSS Syntax, CSS Styling, Text and Fonts properties, CSS Selectors, Different color schemes, CSS Borders, CSS Margins, CSS Backgrounds

**Use case:** Create a website for college

**UNIT – III:**

**JavaScript, RDBMS Concepts and SQL:** JavaScript basics, Functions in Javascript, Javascript validation, Events, Javascript event handling, JavaScript Strings,

JavaScript Dates, Array in Javascript, Document Object Model (Window, Frame, Navigator Objects), Working with Document Object (Its Properties and methods, Cookie handling), Introduction to RDBMS Concepts, Introduction to SQL, Creating and Managing Tables, Data Manipulation, Basic SQL SELECT Statements, Scalar & Aggregate Functions, Joins & Subqueries, Views & Index

**Use case:** Apply validations for Telephone Complaint Registration Form

**Use case:** Create student table for College Management System(CMS)

#### **UNIT – IV:**

**Introduction to C# Programming:** Introduction to .NET Framework 4.5 - What is .NET Framework, .NET Framework, Languages, and Tools, .NET Framework Major Components, Common Language Runtime (CLR), Compilation and Execution in .NET, Understand the .NET Framework 4.5stack, Exploring VS2017, Introduction to C# 6.0 - Features of C#, C# Compilation and Execution, General Structure of a C# Program, Creating and Using a DLL

**Use case:** Create a Console Application (.exe) project called CalcClientApp

#### **UNIT – V:**

**Language Fundamentals of C#:** Language Fundamentals - Keywords, Value Types and Reference Types, Implicit and explicit type conversions, Boxing and Unboxing, Enum, Operators and Assignments, Variables and Literals, Flow

Control: C# Control Statements, Nullable, Classes and Objects, Strings, Array, Generic Collections

**Use case:** Store employee objects using Generic Collections

#### **UNIT – VI:**

**Basics of ADO.NET:** Various Connection Architectures, Understanding ADO.NET and its class library, Important Classes in ADO.NET, Connection Class, Command Class, DataReader Class, DataAdapter Class, DataSet Class

**Use case:** Implement ADO.NET classes that belong to both Connected and Disconnected Architectures

#### **TEXT BOOKS:**

1. Web Programming, Building Internet Applications, Chris Bates, 2<sup>nd</sup> Edition, Wiley Dreamtech
2. Introduction to Database Systems, C. J. Date, Pearson Education
3. Professional C# 2012 with .NET 4.5, Christian Nagel et al. Wiley India, 2012

#### **REFERENCES:**

1. Programming World Wide Web, Sebesta, Pearson
2. Internet and World Wide Web – How to program, Dietel and Nieto PHI/Pearson Education Asia
3. Database Development and Management, Lee Chao, Auerbach Publications, Taylor & Francis Group
4. Pro C# 2010 and the .NET 4 Platform, Andrew Troelsen, 5<sup>th</sup> Edition, A Press, 2010

5. Programming C# 4.0, Ian Griffiths, Matthew Adams, Jesse Liberty, 6<sup>th</sup> Edition, O'Reilly, 2010

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**(A19OE1CS13) INTRODUCTION TO APPLICATION DEVELOPMENT WITH JAVA**

**COURSE OBJECTIVES:**

- To create an integrated development environment for object-oriented Java programs
- To build website menus with CSS and JavaScript
- To relate programming language constructs and problem solving techniques
- To analyze and apply modifications to Java programs that solve real-world problems

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand the fundamentals of HTML5 and define the styles for web pages using CSS

**CO-2:** Create web pages and add dynamic behavior to web pages using Javascript

**CO-3:** Communicate with the database using SQL

**CO-4:** Develop a simple CUI [Character User Interface] based application using Java & SQL

**UNIT – I:**

**Computer:** Computer Fundamentals, Preface to Networks, Networking Levels, Layers of Computer Networks, Protocol Stacks, Networking, and Internet Service

**Software Engineering Fundamentals:** Introduction, Requirements Collection & Analysis, Fundamentals of Software Design, Software Implementation, Types of Testing, Software Maintenance, Overview of Configuration management and version Control Tools, Basics of Agile Process

**Object Oriented Programming:** Object Oriented Paradigm, Classes and Objects, Principles in Object- Oriented technology

**Use case:** Create a class for Bank Account

**UNIT – II:**

**HTML:** Introduction to Web Technology, HTML5 Introduction, HTML5 Elements, Semantic Elements, Table, List, Links in HTML5, Handling of Images, Form Elements, HTML5 Form elements and Attributes, Video & Audio, iframes

**Style Sheets:**

Introduction to CascadingStyleSheet3, CSS Syntax, CSS Styling, Text and Fonts properties, CSS Selectors, Color schemes, CSS Borders, CSS Margins, CSS Backgrounds

**Use case:** Design a website for college

### **UNIT – III:**

**JavaScript:** Introduction to JavaScript, JavaScript Functions, JavaScript validation, Event handling in JavaScript, JavaScript Strings, JavaScript Dates, Array in JavaScript, Document Object Model (Window, Frame, Navigator Objects), Document Object (Its Properties and methods, Cookie handling),

**RDBMS Concepts and SQL:** Introduction to RDBMS Concepts, Introduction to SQL, Creating and Managing Tables, Data Manipulation, Basic SQL SELECT Statements, Scalar & Aggregate Functions, Joins & Subqueries, Views & Index

**Use case:** Check the validations for Telephone Complaint Registration Form

**Use case:** Create student table for College Management System (CMS)

### **UNIT – IV:**

**Introduction to Java:** Java Environment, Java Fundamentals - Keywords, Primitive Data Types, Operators and Assignments, Java's Control Statements, Wrapper Classes, Using Scanner Class, Strings - String Handling functions, Array - One dimensional array, Array of Objects, Using Arrays class, variable length arguments

**Usecase:** To keep track of customers data who are buying products from a store

### **UNIT – V:**

**The Collection Framework:** Lists – Array List, LinkedList, Stack, Vector, Set – HashSet, Linked Hash Set, Tree Set, Map – HashMap, Linked HashMap, Hash table. Retrieving Elements from Collections – Enumeration, Iterator, List Iterator, String Tokenizer – Sorting using Comparable and Comparator.

**Usecase:** Store employee objects using collection framework

### **UNIT – VI:**

**JDBC:** Overview of JDBC, JDBC Architecture, Types of JDBC Drivers. Process SQL with JDBC - Create Connection, Query, Update

**Use case:** Write the menu driven program using JDBC which will have following options

- a. Store
- b. Display by id
- c. Delete by id
- d. Update salary by id
- e. Exit

### **TEXT BOOKS:**

1. Web Programming, Building Internet Applications, Chris Bates, 2<sup>nd</sup> Edition, Wiley Dreamtech
2. Introduction to Database Systems, C. J. Date, Pearson Education
3. Big Java, Cay Horstmann, John Wiley and Sons, 2<sup>nd</sup> Edition

### **REFERENCES:**

1. Programming World Wide Web, Sebesta, Pearson
2. Internet and World Wide Web – How to program, Dietel and Nieto PHI/Pearson Education Asia

3. Database Development and Management, Lee Chao, Auerbach Publications, Taylor & Francis Group
4. Java How to Program, H. M. Dietel and P. J. Dietel, 6<sup>th</sup> Edition, Pearson Education/PHI
5. Core Java 2, Vol. 1, Fundamentals, CayS. Horstmann and Gary Cornell, 7<sup>th</sup> Edition, Pearson Education

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**(A19OE1CS14) INTRODUCTION TO APPLICATION DEVELOPMENT WITH PYTHON**

**COURSE OBJECTIVES:**

- To create an integrated development environment for object-oriented Python programs
- To build website menus with CSS and JavaScript
- To relate programming language constructs and problem solving techniques
- To analyze and apply modifications to Python programs that solve real-world problems

**COURSE OUTCOMES:** After completion of the course, the student should be able to

**CO-1:** Understand the fundamentals of HTML5 and define the styles for web pages using CSS

**CO-2:** Create web pages and add dynamic behavior to web pages using Javascript

**CO-3:** Communicate with the database using SQL

**CO-4:** Develop a simple CUI [Character User Interface] based application using Python & SQL

**UNIT – I:**

**Concepts of Networks, Overview of Software Engineering & OOP:** Computer Basics, Network basics, Networking Levels, Layers and Protocols, Protocol Stacks, Networking and services of Internet

**Software Engineering lifecycle** - Overview of Requirement Analysis, Software Design, Implementation of software, Outline of Testing, Maintenance, Configuration management and version Control, Agile fundamentals

**OOP** - Object Oriented Concepts, OOP Principles

**Use case:** Create a class for Employee Account

**UNIT – II:**

**Introduction to Web Technology:** Overview of Web Technology, Introduction to HTML5, HTML5 Elements, Semantic Elements, Table, List, Links, Image Handling, Form-Input Elements, HTML5 Form elements, HTML5 Attributes, Video & Audio, iframes,

**CSS** - Introduction to CSS3, CSS Syntax, CSS Styling, Text and Fonts properties, CSS Selectors, Different color schemes, CSS Borders, Margins, Backgrounds

**Use case:** Create a website for an institution

**UNIT – III:**

**Outline of JavaScript, RDBMS Concepts and SQL:** JavaScript basics, Functions, validations, Events, handling events, Strings, Dates, Arrays, DOM(Window, Frame,

Navigator Objects), Document Object -Properties and methods, handling of Cookies,

RDBMS Concepts, SQL, Management of Tables, Manipulation of tables, SQL SELECT Statements, Scalar & Aggregate Functions, Joins & Sub queries, Views & Index

**Use case:** Apply validations for Telephone Complaint Registration Form

**Use case:** Create student table for College Management System (CMS)

#### **UNIT – IV:**

**Introduction to Python:** Introduction, Features of Python, Versions, Keywords and Identifiers, Statements & Comments, Variables, Datatypes, Type Conversion, I/O and import, Language Fundamentals - Operators, Namespace, Modules in Python, Python DateTime

**Use case:** Develop an application using Python for accepting your personal details and display the same

#### **UNIT – V:**

**Classes and Objects:** Classes and Objects in Python? Advantages of Using Classes in Python, Defining a Class in Python, Creating an Object in Python, The self, The\_init\_() function in Python, class and instance variables, Python Inheritance and its Types, Strings, Lists, Sets, Tuples, Dictionary

**Use case:** Store employee objects using various data structures

#### **UNIT – VI:**

**Advance Concepts in Python:** Array - What is an Array, Difference between Array and List in Python, Creating an Array, Accessing a Python Array Element, Basic Operations of Arrays, Functions - Creating a Function, Calling a Function, Pass by reference vs value, Required arguments, Keyword arguments, Default arguments, Variable-length arguments, The Anonymous Functions, The return Statement, Global vs. Local variables, Modules - What is a Module?, Create a Module, Use a Module, Variables in Module, Naming a Module, Renaming a Module, Built-in Modules, Using the dir() Function, Import From Module, Packages, NumPy

**Use case:** Develop an application for Hospital Management System(HMS)

#### **TEXT BOOKS:**

1. Web Programming, Building Internet Applications, Chris Bates, 2<sup>nd</sup> Edition, Wiley Dreamtech
2. Introduction to Database Systems, C. J. Date, Pearson Education
3. Python Programming: A Modern Approach, Vamsi Kurama, Pearson

#### **REFERENCES:**

1. Programming World Wide Web, Sebesta, Pearson
2. Internet and World Wide Web – How to program, Dietel and Nieto PHI/Pearson Education Asia
3. Database Development and Management, Lee Chao, Auerbach Publications, Taylor & Francis Group
4. Core Python Programming, W. Chun, Pearson



4. Introduction to Python, Kenneth A. Lambert, Cengage