Name of Department:- Computer Science and Engineering

1. Subject Code: TCS 451 Course Title: **Virtualization and Cloud Computing**

2.Contact Hours: L: 3 - 2

3. Semester: IV
4. Pre-requisite: TCS 101, TCS351
5. Course Outcomes: After completion of the course students will be able to
    1. Discuss the different paradigms of cloud computing.
    2. Contrast parallel and distributed computing.
    3. Identify the concept of virtualization technique.
    4. Apply virtualization technique in cloud computing platform.
    5. Describe the architectures of cloud computing.
    6. Demonstrate the Use case of the virtualization and cloud computing services.

6 Detailed Syllabus

UNIT	CONTENTS	Contact Hrs
Unit - I	**Introduction to Cloud Computing** Why Cloud Computing (CC)? Different Perspectives on CC, Different Stakeholders in CC, Total cost of ownership (TCO) of on-premises IT, Cloud Computing Taxonomy, Characteristics of cloud computing, Characteristics of cloud computing as per NIST, Cloud DefinitionsCloud Computing at a Glance, The Vision of Cloud Computing, Cloud Computing Reference Model, 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	**9**
Unit - II	**Virtualization** Introduction, Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques, Execution Virtualization, Types of hardware virtualization: Full virtualization - partial virtualization - para virtualization Desktop virtualization: Software virtualization – Memory virtualization - Storage virtualization – Data Virtualization – Network virtualizationVirtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples, Xen: Para virtualization, VMware: Full Virtualization, Microsoft Hyper-V.	**9**
Unit – III	**Virtual Machines** Virtual machines basics, Process virtual machines: Memory architecture emulation, Instruction emulation, Operating system emulation, Dynamic binary optimization, High level VN architecture, System virtual machines: Resource virtualization (Processors, Memory, Input/Output), Case Study of Intel VT-x	**8**
Unit – IV	**Parallel and Distributed Computing** Eras of Computing, Parallel vs. Distributed Computing, Elements of Parallel Computing, What is Parallel Processing?, Hardware Architectures for Parallel Processing, Approaches to Parallel Programming, Levels of Parallelism, Laws of Caution, Elements of Distributed Computing, General Concepts and Definitions, Components of a Distributed System, Architectural Styles for Distributed Computing, Models for Inter-Process Communication, Technologies for Distributed Computing, Remote Procedure Call, Distributed Object Frameworks, Service Oriented Computing	**8**
Unit – V	**Cloud Computing Architecture** Fundamental Cloud Architectures - Workload Distribution Architecture - Resource Pooling Architecture - Dynamic Scalability Architecture – Elastic Resource Capacity Architecture -Service Load Balancing Architecture – Cloud Bursting Architecture - Elastic Disk Provisioning Architecture – Redundant Storage Architecture. Cloud Computing Reference Architecture (CCRA):	**9**

	Introduction, benefits of CCRA, Migrating into a Cloud: Introduction, Challenges while migrating to Cloud, Broad approaches to migrating into the cloud, Seven-step model of migration into a cloud, Migration Risks and Mitigation.	
	Total	**43**

Text Books:

- Mastering Cloud Computing by RajkumarBuyya etc., Published by McGraw Hill, 2013
- Virtual Machines by James E. Smith, Ravi Nair, Published by MK Publishers
- V K Pachghare, Cloud Computing, PHI, 2016

Reference Books:

- Barrie Sosinsky , Cloud Computing Bible, Wiley Publishing Inc.,2011

Name of Department:- Computer Science and Engineering

1. Subject Code: TCS 471 Course Title: **Statistical Data Analysis with R**
2. Contact Hours: L: 3 T: - P: 2
3. Semester: IV

4. Pre-requisite: TMA101, TCS 201, TCS351

5. Course Outcomes: After completion of the course students will be able to

1. Understand the concepts of statistics
2. Apply the probability distribution techniques in different applications.
3. Understand the needs of data preprocessing
4. Implement the manipulation and processing of data in R
5. Apply the concepts of functions in R
6. Understand the use of R in data Analytics

6. Detailed Syllabus

UNIT	CONTENTS	Contact Hrs
Unit – I	**Statistics:** Introduction to Statistics- Descriptive Statistics, Summary Statistics Basic probability theory, Statistical Concepts (uni-variate and bi-variate sampling, distributions, re-sampling, statistical Inference, prediction error),	**9**
Unit - II	**Probability Distribution:** Introduction to Probability, Probability Distribution (Continuous and discrete- Normal, Bernoulli, Binomial, Negative Binomial, Geometric and Poisson distribution) , Bayes' Theorem, Central Limit theorem, Data Exploration & preparation, Concepts of Correlation, Regression, Covariance, Outliers.	**10**
Unit – III	**Introduction to R and Data Preprocessing:** Introduction & Installation of R, R Basics, Finding Help, Code Editors for R, Command Packages, Manipulating and Processing Data in R, Reading and Getting Data into R, Exporting Data from R	**10**
Unit – IV	**Objects and Data Types**: Data Objects-Data Types & Data Structure. Viewing Named Objects, Structure of Data Items, Manipulating and Processing Data in R (Creating, Accessing, Sorting data frames, Extracting, Combining, Merging, reshaping data frames), Control Structures	**8**
Unit – V	**Functions:**Functions in R (numeric, character, statistical), working with objects, Viewing Objects within Objects, Constructing Data Objects, Building R Packages, Running and Manipulating Packages, Non parametric Tests-ANOVA, chi-Square, t-Test, U-Test, Introduction to Graphical Analysis, Using Plots(Box Plots, Scatter plot, Pie Charts, Bar charts, Line Chart), Plotting variables, Designing Special Plots, Simple Liner Regression, Multiple Regression	**9**
	Total	**46**

Text/ Reference Books:

1. Dr. Mark Gardener, “Beginning R: The Statistical Programming Language”, John willey& Sons, 2012
2. John M. Quick, “Statistical Analysis with R”, Pckt Publishing, 2010

Name of Department:- Computer Science and Engineering

1. Subject Code: TCS 491 Course Title: **Introduction to Cryptography**
2. Contact Hours: L: 3 T: - P: 2
3. Semester: IV
4. Pre-requisite: None
5. Course Outcomes: After completion of the course students will be able to

    1. Classify security vulnerabilities involved in data communication over Internet and make use of classical algorithms to address the vulnerabilities.
    2. Make use of symmetric block ciphers to secure data transmission and storage
    3. Analyze challenges involved in key distribution and select approache that can be adopted
    4. Evaluate different Public Key algorithms, their mathematical background and make use of the same for data communication and message authentication
    5. Categorize types of viruses, worms, intrusion and decide measures to counter the threats.
    6. Criticize the legal aspects related to Cybercrime, Intellectual Property, Privacy, Ethical Issues.
6. Detailed Syllabus

UNIT	CONTENTS	Contact Hrs
Unit - I	Introduction: Computer Security Concepts: The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, a Model for Network Security, Standards Cryptography fundamentals and terminology; Cryptanalysis and Brute-Force Attack, Fundamental techniques of cryptography – Substitution and Transposition; Classical Ciphers; Basics of Steganography	**8**
Unit - II	Modern Cryptography : Symmetric Encryption and Message Confidentiality: Symmetric Encryption Principles,Fiestal structure. Symmetric Block Encryption Algorithms Simple DES, DES and Simple AES, Stream Ciphers and RC4, Random and Pseudorandom Numbers,	**9**
Unit – III	Symmetric key distribution using symmetric encryption: A Key Distribution Scenario, Session Key Lifetime, A Transparent Key Control Scheme, Decentralized Key Control, Controlling Key Usage Mathematical Background for cryptography: Prime and Relatively Prime Numbers, Euclid's algorithm for GCD, Extended Euclid's Algorithm for Multiplicative Inverse, Euler's Totient function.	**10**
Unit – IV	Public-Key Cryptography: Public-Key Encryption Structure, Applications for Public-Key Cryptosystems, Requirements for Public-Key Cryptography, The RSA Public-Key Encryption Algorithm, Digital Signature. Message Authentication: Approaches to Message Authentication, Authentication Using Conventional Encryption, Message Authentication without Message Encryption, MD5 Hash Algorithm.	**9**
Unit – V	Electronic mail security-pretty good privacy (PGP). System Security: Intruders, Intrusion Detection, Password Management, Types of Malicious Software, Viruses, Virus Countermeasures, Worms and Principles of Firewalls Legal and Ethical Aspects: Cybercrime and Computer Crime,	**8**

	Intellectual Property, Privacy, Ethical Issues	
	Total	**44**

Text Books:

- William Stallings, Network Security Essentials – Applications and Standards, 4th edition, Pearson Education, 2011
- William Stallings , Cryptography and Network Security, 7th Edition , Pearson Education, 2017

Reference Books:

- Behrouz Forouzan , Cryptography and Network Security, 3rd Edition, McGraw Hill, 2015
- Atul Kahate, "Cryptography and Network Security", Third edition, McGraw Hill Education, 2017.

Name of Department:- Computer Science and Engineering

1. Subject Code: TCS 421 Course Title: **Fundamental of Statistics and AI**
2. Contact Hours: L: 3 T: 1 P: 2
3. Semester: IV

4. Pre-requisite: TMA101, TMA201

5. Course Outcomes: After completion of the course students will be able to

1. Demonstrate knowledge of statistical and exploratory data analysis data analysis techniques utilized in decision making.
2. Apply principles of Data Science to the analysis of business problems.
3. To use Machine Learning Algorithms to solve real-world problems.
4. To provide data science solution to business problems and visualization.
5. To learn the basic concepts and techniques of AI and machine learning
6. To explore the various mechanism of Knowledge and Reasoning used for building expert system.

6.Detailed Syllabus

Sl. No.	Contents	Contact Hours
1	**Introduction to AI** Definition, Problem, State space representation. Intelligent Systems: Categorization of Intelligent System, Components of AI Program, Foundations of AI, Applications of AI, Current trends in AI, Intelligent Agents: Anatomy, structure, Types.	10
2	**Problem solving** Solving problem by Searching: Problem Solving Agent, Formulating Problems. Uninformed Search Methods: Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, Depth First Iterative Deepening (DFID), Informed Search Methods: Greedy best first Search, A* Search, Memory bounded heuristic Search. Local Search Algorithms and Optimization Problems: Hill climbing search Simulated annealing, Local beam search.	9
3	**An Introduction to Data Science** Definition, working, benefits and uses of Data Science, Data science vs BI, The data science process, Role of a Data Scientist.	9

4	**Statistical Data Analysis & Inference** Populations and samples, Statistical modelling, probability distributions, fittings a model, Statistical methods for evaluation, Exploratory Data Analysis, Getting started with R, Manipulating and Processing data in R, working with function in R, Working with descriptive Statistics, Working with graph plot in R.	9
5	**Statistical Applications** Basic Statistical operations, Linear Regression Analysis, Logistic and Exponential Regression, Time Series Analysis, Probability Distribution, ANOVA, Correlation and Covariance.	8
	Total	**45**

Text/ Reference Books:

1. Tom M. Mitchell. "Machine Learning" McGraw-Hill, 1997.
2. “Statistical programming in R”, Oxford University Press 2017