105805	Cloud Computing	3L:0T:0P	3 Credits

Objective: This course will cover the study of various cloud services, deployment model, resource provisioning and scheduling algorithms involved in better implementing the cloud-based systems.

Detailed contents

Module 1 **Lecture 4 hrs.**

Introduction: Distributed Computing and Enabling Technologies, Cloud Fundamentals: Cloud Definition, Evolution, Architecture, Applications, deployment models, and service models.

Module 2 **Lecture 5 hrs.**

Virtualization: Issues with virtualization, virtualization technologies and architectures, Internals of virtual machine monitors/hypervisors, virtualization of data centers, and Issues with Multi-tenancy.

Module 3 **Lecture 6 hrs.**

Implementation: Study of Cloud computing Systems like Amazon EC2 and S3, Google App Engine, and Microsoft Azure, Build Private/Hybrid Cloud using open source tools, SLA management.

Module 4 **Lecture 12 hrs.**

Resource Management: Cloud resource provisioning plan (advance reservation, on demand plan, spot instances), various scheduling and load balancing techniques to improve QoS parameters, Resource Optimization algorithms, task migration and VM migration technique.

Module 5 **Lecture 7 hrs.**

Security: Vulnerability Issues and Security Threats, Application-level Security, Data level Security, and Virtual Machine level Security, Infrastructure Security, and Multi-tenancy Issues.

Module 6 **Lecture 6 hrs.**

Advances: Green Cloud, Mobile Cloud Computing, Fog Computing, Internet of Things

Suggested Books:

1. Cloud Computing Principles and Paradigms, RajkumarBuyya, James Broberg, AndrzejGoscinski, Wiley Publishers 2011
2. Cloud Computing Bible, Barrie Sosinsky, Wiley Publishers 2010
3. Mastering Cloud computing, RajkumarBuyya, Christian Vacchiola, S ThamaraiSelvi, McGraw Hill 2013
4. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, SubraKumaraswamy, ShahedLatif, O'Reilly 2010
5. Cloud Computing by Shailendra Singh 2018

Course outcomes:

1. Articulate the main concepts, key technologies, strengths, and limitations of cloud computing

and the possible applications for state-of-the-art cloud computing

2. Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
3. Identify problems, and explain, analyze, and evaluate various cloud computing solutions
4. Provide the appropriate cloud computing solutions and recommendations according to the applications used.
5. Attempt to generate new ideas and innovations in cloud computing

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105810	Big Data Analytics	3L:0T:0P	3 Credits

Course Objectives:

1. To understand the competitive advantages of big data analytics
2. To understand the big data frameworks
3. To learn data analysis methods
4. To learn stream computing
5. To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive forbig data analytics

Detailed contents

Module 1 **Lecture 7 hrs.**

Introduction to Big Data: Definition, Characteristic Features, Big Data Applications, Big Data vs TraditionalData, Risks of Big Data, Structure of Big Data, Challenges of Conventional Systems, WebData, Evolution of Analytic Scalability, Evolution of Analytic Processes, Tools and methods, Analysis vs Reporting, Modern Data Analytic Tools.

Module 2 **Lecture 9 hrs.**

HADOOP Framework: Distributed File Systems, Large-Scale FileSystem, Organization – HDFS concepts – MapReduceExecution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN

Module 3 **Lecture 10 hrs.**

Data Analysis: Statistical Methods:Regression modelling, Multivariate Analysis - Classification: SVM & KernelMethods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods,Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based ClusteringMethods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R.

Module 4 **Lecture 7 hrs.**

Mining Data Streams: Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream – MiningData Streams and Mining Time-series data - Real Time Analytics Platform (RTAP) Applications -Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

Module 5 **Lecture 9 hrs.**

Big Data Frameworks: Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations –Hbase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – HadoopIntegration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts.Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation –HiveQL Queries

Course Outcomes:

At the end of this course, the students will be able to:

1. Understand how to leverage the insights from big data analytics
2. Analyze data by utilizing various statistical and data mining approaches
3. Perform analytics on real-time streaming data

4. Understand the various NoSql alternative database models

Suggested Reference Books:

1. Bill Franks, —Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, Wiley and SAS Business Series, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
3. Michael Berthold, David J. Hand, —Intelligent Data Analysis‖, Springer, Second Edition, 2007.
4. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
5. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
6. Richard Cotton, "Learning R – A Step-by-step Function Guide to Data Analysis, , O'Reilly Media, 2013.

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105816	EmbeddedSystems	3L:0T:0P	3 Credits

Detailed contents

Module 1 **Lecture 10 hrs.**

Embedded Computing: Introduction, Complex systems and Microprocessors, The embedded system design process, Formalization for system design.

Module 2 **Lecture 10 hrs.**

Instruction Sets CPUs: Instruction and preliminaries ARM and SHARC Processors, Programming I/O CPU performance and Power consumption.

Module 3 **Lecture 10 hrs.**

The embedded Computing Platform and program design: Introduction, the CPU bus, Component interfacing, designing with microprocessors, development and debugging.

Module 4 **Lecture 10 hrs.**

Program Design and Analysis: Introduction program design, Assembly, Linking, Basic compilation techniques, and Analysis optimization of executive time.

Text Book:

1. Wayner Wolf., "Computers as components – Principle of Embedded Computing System Design", Morgan Kaufmann/ Hercourt India Pvt. Ltd.

Reference Books:

1. Raj Kamal - Embedded Systems, TMH, New Delhi 2004.

2. F. Vahid& T. givargis- Embedded system Design, John wiley, India Edition, 2005.

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105819	Ad-hoc and Sensor Networks	3L:0T:0P	3 Credits

Objectives:

- Understand the design issues in Ad Hoc and Sensor Networks.
- Learn the different types of MAC protocols.
- Be familiar with different types of Ad-hoc routing protocols.
- Be expose to the TCP issues in Ad-hoc networks.
- Learn the architecture and protocols of wireless sensor networks.

Detailed contents

Module 1: Introduction **Lectures 8 hrs.**

Fundamentals of wireless communication technology – the electromagnetic spectrum – radio propagation mechanisms – characteristics of the wireless channel – Mobile Ad-hoc Networks (MANETS) and Wireless Sensor Networks (WSNs): concepts and architectures. Applications of Ad-hoc and sensor networks. Design challenges in Ad-hoc and sensor networks.

Module 2: Mac Protocols for Ad-hoc Wireless Networks **Lectures 8 hrs.**

Issues in designing a MAC Protocol- Classification of MAC Protocols- Contention based protocols Contention based protocols with Reservation Mechanisms- Contention based protocols with Scheduling Mechanisms – Multi channel MAC-IEEE 802.11

Module 3: Routing Protocols and Transport Layer in Ad-hoc Networks **Lectures 8 hrs.**

Issues in designing a routing and Transport Layer protocol for Ad hoc networks-proactive routing, reactive routing (on-demand), hybrid routing- Classification of Transport Layer solutions-TCP over Ad hoc wireless Networks.

Module 4: Wireless Sensor Networks (WSNs) And MAC Protocols **Lectures 8 hrs.**

Single node architecture: hardware and software components of a sensor node - WSN Network architecture: typical network architectures-data relaying and aggregation strategies -MAC layer protocols: self-organizing, Hybrid TDMA/FDMA and CSMA based MAC- IEEE 802.15.4

Module 5: Security in Ad Hoc and Sensor Networks **Lectures 8 hrs.**

Security Attacks – Key Distribution and Management – Intrusion Detection – Software based Anti-tamper techniques – Water marking techniques – Defense against routing attacks – Secure Ad hoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS

Text Book:

1. C.Siva Ram Murthy and B.S.Manoj, —Ad Hoc Wireless Networks – Architectures and Protocols, Pearson Education, 2006.

2.HolgerKarl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”,Wiley, 2005

References Book:

1. Carlos De Morais Cordeiro, Dharma Prakash Agrawal “Ad Hoc & Sensor Networks: Theory and Applications”, World Scientific Publishing Company, 2006.

2. Feng Zhao and Leonides Guibas, "Wireless Sensor Networks", Elsevier Publication - 2002.

Course Outcomes:

Upon completion of the course, the student should be able to:

1. Identify different issues in wireless ad hoc and sensor networks.
2. Analyze protocols developed for ad hoc and sensor networks.
3. Identify and understand security issues in ad hoc and sensor networks.

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