
# M. Tech. Computer Science and Engineering

# (CBCS)

# Syllabus Effective From 2018-19

## FIRST YEAR COMPUTER SCIENCE AND ENGINELNERING (M.TECH-I) – CBCS PATTERN

| | SEMESTER - I | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sr. No | Course (Subject Title) | TEACHING SCHEM | | | | | | | | | EXAMINATION SCHEME | | | | | | | | | | | | | | |
| | | THEORY | | | TUTORIAL | | | PRACTICAL | | | THEORY | | | | | | PRACTICAL | | | TERM WORK | | | | | |
| | | Credits | No. of Lecture | Hours | Credits | No. of Lecture | Hours | Credits | No. of Lecture | Hours | Hours | Mode | Marks | Total Marks | Min | Hours | Mode | Max | Min | Hours | Max | Min | | | |
| 1 | PCC-CSE-101 | 3 | 3 | 3 | 1 | 1 | 1 | - | - | - | | CIE | 30 | 100 | 12 | As per BOS Guidelines | - | - | - | - | 25 | 10 | | | |
| | | | | | | | | | | | | ESE | 70 | | 28 | | | | | | | | | | |
| 2 | PCC-CSE-102 | 3 | 3 | 3 | - | - | - | 1 | 2 | 2 | | CIE | 30 | 100 | 12 | | - | - | - | - | 25 | 10 | | | |
| | | | | | | | | | | | | ESE | 70 | | 28 | | | | | | | | | | |
| 3 | PCC-CSE-103 | 3 | 3 | 3 | - | - | - | 1 | 2 | 2 | | CIE | 30 | 100 | 12 | | - | - | - | - | 25 | 10 | | | |
| | | | | | | | | | | | | ESE | 70 | | 28 | | | | | | | | | | |
| 4 | PCE-CSE-101 | 3 | 3 | 3 | - | - | - | - | - | - | | CIE | 30 | 100 | 12 | | - | - | - | - | 25 | 10 | | | |
| | | | | | | | | | | | | ESE | 70 | | 28 | | | | | | | | | | |
| 5 | PCE-CSE-102 | 3 | 3 | 3 | 1 | 1 | 1 | - | - | - | | CIE | 30 | 100 | 12 | | - | - | - | - | 25 | 10 | | | |
| | | | | | | | | | | | | ESE | 70 | | 28 | | | | | | | | | | |
| 6 | PW-CSE-101 | - | - | - | - | - | - | 1 | 2 | 2 | | - | - | - | - | | - | - | - | - | 25 | 10 | | | |
| | **TOTAL** | **15** | **15** | **15** | **2** | 2 | 2 | **3** | **6** | **6** | | | | **500** | | | | | | | **150** | | | | |

CIE- Continuous Internal Evaluation, ESE – End Semester Examination

| SEMESTER - II | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sr. No | Course (Subject Title) | TEACHING SCHEM : | | | | | | | | | EXAMINATION SCHEME | | | | | | | | | | | | | | | |
| | | THEORY | | | TUTORIAL | | | PRACTICAL | | | THEORY | | | | | | PRACTICAL | | | | TERM WORK | | | | | |
| | | Credits | No. of Lecture | Hours | Credits | No. of Lecture | Hours | Credits | No. of Lecture | Hours | Hours | Mode | Marks | Total Marks | Min | Hours | Mode | Max | Min | | Hours | Max | Min | | | |
| 1 | PCC-CSE-201 | 3 | 3 | 3 | 1 | 1 | 1 | - | - | - | | CIE | 30 | 100 | 12 | As per BOS Guidelines | - | - | - | | - | 25 | 10 | | | |
| | | | | | | | | | | | | ESE | 70 | | 28 | | | | | | | | | | | |
| 2 | PCC-CSE-202 | 3 | 3 | 3 | - | - | - | 1 | 2 | 2 | | CIE | 30 | 100 | 12 | | - | - | - | | - | 25 | 10 | | | |
| | | | | | | | | | | | | ESE | 70 | | 28 | | | | | | | | | | | |
| 3 | PCE-CSE-201 | 3 | 3 | 3 | - | - | - | 1 | 2 | 2 | | CIE | 30 | 100 | 12 | | - | - | - | | - | 25 | 10 | | | |
| | | | | | | | | | | | | ESE | 70 | | 28 | | | | | | | | | | | |
| 4 | PCE-CSE-202 | 3 | 3 | 3 | 1 | 1 | 1 | - | - | - | | CIE | 30 | 100 | 12 | | - | - | - | | - | 25 | 10 | | | |
| | | | | | | | | | | | | ESE | 70 | | 28 | | | | | | | | | | | |
| 5 | PCE-CSE-203 | 3 | 3 | 3 | | | | - | - | - | | CIE | 30 | 100 | 12 | | - | - | - | | - | 25 | 10 | | | |
| | | | | | | | | | | | | ESE | 70 | | 28 | | | | | | | | | | | |
| 6 | PW-CSE-201 | - | - | - | - | - | - | 1 | 2 | 2 | | | | | | | - | - | - | | - | 25 | 10 | | | |
| | **TOTAL** | **15** | **15** | **15** | **2** | 2 | 2 | **3** | **6** | **6** | | | | **500** | | | | | | | | **150** | | | | |

CIE- Continuous Internal Evaluation, ESE – End Semester Examination

| | |
|---|---|
| • Candidate contact hours per week : 30 Hours (Minimum) | • Total Marks SEM I & II: **1300** |
| • Theory/Tutorial Duration : 60 Minutes and Practical Duration : 120 Minutes | • Total Credits. SEM I & II: **40** |
| • In theory examination there will be a passing based on separate head of passing for examination of CIE and ESE. | |
| • There shall be separate passing for theory and practical (term work) courses. | |

## COURSE CODE AND DEFINITION

### Semester I

| Sr. No | Code No. | Subject | Credits |
|---|---|---|---|
| 1. | PCC-CSE-101 | Mathematical Foundations of Computer Science (MFCS) | 4 |
| 2. | PCC-CSE-102 | Design of Database Systems | 4 |
| 3. | PCC-CSE-103 | Advanced Algorithms | 4 |
| 4. | PCE-CSE-101 | Elective – I | 3 |
| 5. | PCE-CSE-102 | Elective-II | 4 |
| 6. | PW-CSE-101 | Research Methodology | 1 |
| | | **TOTAL** | **20** |

| Sr. No | Elective-I | Elective-II |
|---|---|---|
| 1 | Advanced Network Protocol | Cloud and Virtualization |
| 2 | Ad-hoc Wireless Network | High Performance Computing Architectures |
| 3 | Pervasive Computing | Advanced Operating Systems |

## Semester II

| Sr. No | Code No. | Subject | Credits |
|---|---|---|---|
| 1. | PCC-CSE-201 | Systems and Information Security | 4 |
| 2. | PCC-CSE-202 | Machine Learning | 4 |
| 3. | PCE-CSE-201 | Elective – III | 4 |
| 4. | PCE-CSE-202 | Elective-IV | 4 |
| 5. | PCE-CSE-303 | Elective-V | 3 |
| 6. | PW-CSE-201 | Seminar – I | 1 |
| | | **TOTAL** | **20** |

| Sr. No | Elective-III | Elective-IV | **Elective V (open) |
|---|---|---|---|
| 1 | Data Analytics | Deep Learning | Parallel and Distributed Computing |
| 2 | Data Warehousing and Data Mining | Computer Vision | Information Retrieval |
| 3 | Business Analytics | Pattern Recognition | Natural Language Processing |

# SECOND YEAR COMPUTER SCIENCE AND ENGINELNERING (M.TECH-II)– CBCS PATTERN

| Sr. No | Course (Subject Title) | TEACHING SCHEME | | | | | | | | | EXAMINATION SCHEME | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | THEORY | | | TUTORIAL | | | PRACTICAL | | | THEORY | | | | | | PRACTICAL | | | TERM WORK | | | |
| | | Credits | No. of Lecture | Hours | Credits | No. of Lecture | Hours | Credits | No. of Lecture | Hours | Hours | Mode | Marks | Total Marks | Min | Hours | Modes | Max | Min | Hours | Max | Min | |
| **SEMESTER –III** | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | PW-CSE-301 | - | - | - | - | - | - | 2 | 4 | 4 | - | - | - | - | - | As per BOS Guidelines | | - | - | - | 50 | 20 | |
| 2 | PW-CSE-302 | - | - | - | - | - | - | 2 | 4 | 4 | - | - | - | - | - | | | | | | 50 | 20 | |
| 3 | PW-CSE-303 | | | | | | | 8 | 16 | 16 | | | | | | | | | | | 100 | 40 | |
| | **TOTAL** | - | - | - | - | - | - | **12** | **24** | **24** | | | | | | | | | | | **200** | | |
| **SEMESTER –IV** | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | PW-CSE-401 | - | - | - | - | - | - | 16 | 32 | 32 | - | - | - | - | - | | OE | 100 | 40 | | 100 | 40 | |
| | **TOTAL** | - | - | - | - | - | - | **16** | **32** | **32** | | | | | | | | **100** | | | **100** | | |
| | **TOTAL** | - | - | - | - | - | - | **28** | **56** | **56** | | | | | | | | **100** | | | **300** | | |

- Total Marks for Sem III & IV :**400**
- Total Credits for Sem III & IV : **28**
- In theory examination there will be a passing based on separate head of passing for examination of CIE and ESE.
- There shall be separate passing for theory and practical (term work) courses.

**Semester III**

| Sr. No | Code No. | Subject | Credits |
|---|---|---|---|
| 1. | PW-CSE-301 | *e-learning Course | 2 |
| 2. | PW-CSE-302 | # Seminar II | 2 |
| 3. | PW-CSE-302 | ##Dissertation Phase-I | 8 |
| | | TOTAL | **12** |

**Semester IV**

| Sr. No | Code No. | Subject | Credits |
|---|---|---|---|
| 1. | PW-CSE-401 | #Dissertation Phase-II | 16 |
| | | TOTAL | **28** |

**Note :**

* e-learning course :- Students are supposed to complete e-learning course from MOOCS/NPTEL/Swayam related to Dissertation work and not covered in M. Tech Sem I and Sem II and as per suggestions from respective guide.

*For seminar I, Seminar II work load will be for two students

** Open elective: - Students can take any subject from other PG discipline being conducted in the same Institute and with the consent of their Guide/PG Faculty from program of study.

# Seminar II should be on advanced technology related to Dissertation topic.

## Dissertation Phase I , Dissertation phase II work load will be for one student.

# PCC-CSE-101 Mathematical Foundations of Computer Science

**Theory :** 3 Hr/Week
**Tutorial:** 1 Hr/Week
**Marks :** 100
**Term Work :** 25

## Course Objectives

1. To enhance the problem solving skills in the areas of theoretical computer science.
2. To use the mathematical concepts in the development of computer applications.
3. To make the student aware of mathematical tools, formal methods & automata techniques to computing.
4. To strengthen the students' ability to carry out formal and higher studies in computer science.

## Course Outcomes

At the end of the course students will be able to

1. Use mathematical concepts in the development of language design.
2. Design regular expressions and automata for different language classes.
3. Design context free grammar and push down automata for different applications.
4. Describe different types of Turing Machine their use, capability, and limitations.
5. Determine decidability and reducibility of computational problems.
6. Determine Computability and Computational Complexity.

## Course Contents

**Unit 1. Introduction** **5 Hrs.**

Mathematical notions and terminology of sets, sequences and tuples, functions and relations graphs, strings and languages. Boolean logic properties and representation. Definitions, Theorems and types of proofs, formal proofs, deductive, reduction to definition, proof by construction, contradiction, induction, indirect, automatic, counter-examples

**Unit 2. State Machines and Grammars** **8 Hrs.**

Types of Languages, Types of grammar, recurrence relations, Regular expressions, Finite State Machines, DFA, NFA, Equivalence of DFA & NFA., Kleen's Theorem, pumping Lemma, Applications 5 Push down automata and CFG PDA, N-PDA, CFG, ambiguous grammar, non ambiguous grammar, CNF, Parsers: Top-down, Bottom-up, applications

**Unit 3. Turing Machines** **6 Hrs.**

Turing machines, variations of TMs, Combining TM's, programming techniques for TMs, Universal Turing Machines, recursive and recursively enumerable languages

**Unit 4. Decidability and Reducibility** **7 Hrs.**

Decidable languages, decidable problems concerning context-free languages, FA, PDA, Turing Machines, Undecidable problems from language theory,A simple undecidable problem (PCP), The halting problem- Diagonalization method, Reduction problems, mapping reducibility

**Unit 5. Computability** **5 Hrs.**

Primitive recursive functions, computable functions, primitive recursive functions. Computability examples, the recursion theorem

**Unit 6. Computational Complexity** **5 Hrs**

Tractable and intractable problems, growth rates of functions. Time complexity of TM. Tractable decision problems. Theory of Optimization

## Reference Books


1 "Introduction to Theory of Computation", Michael Sipser, Thomson Brools Cole.

2 "Introduction to Automata Theory, Language and Computations", J.E. Hoperoft, Rajeev Motwani & J. D. Ullman, Pearson Education Asia, 2nd Edition.

3 "Introduction to Languages and Theory of Computation", John. Martin MGH.3rd Edition

4 "Discrete Mathematical Structures with Applications to Computer Science", J. P. Trembley and R. Manohar.

5 "Theory of Computer Science", E. V. Krishamoorthy.

# PCC-CSE-102 Design of Database Systems

**Theory :** 3 Hr/Week
**Practical:** 2 Hr/Week
**Marks :** 100
**Term Work :** 25

## Course Objectives

1. To make students aware of phases of database design, database system development life cycle and design methodology.
2. To acquire knowledge on parallel and distributed databases and its applications.
3. To expose to the students the design issues in specialized databases.
4. To address designing of graph and cloud databases for scalable performance

## Course Outcomes

At the end of the course students will be able to

1. Describe basic concepts of database types
2. Explain security issues of database
3. Explain special and temporal databases
4. Describe cloud database activities
5. Explain graph databases

## Course Contents

**Unit 1. Database Planning, Design and Administration** **6 Hrs.**

The information system lifecycle, the database system development lifecycle, database planning, system definitions, requirement collection and analysis, database design, DBMS selection, application design, prototyping, implementation, data conversion and loading, testing, operational maintenance, CASE tools, data and database administration.

**Unit 2. Parallel and Distributed Databases** **7 Hrs.**

Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems- Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Case Studies.

**Unit 3. Security and Authorization** **6 Hrs.**

Introduction to database security, access control, discretionary access control, mandatory access control, security for internet applications, additional issues related to security. Case study : Security and authorization in Oracle / IBM DB2.

**Unit 4. Spatial, Temporal & Multimedia Databases** **6 Hrs.**

Motivation, Time in databases, Spatial and Geographic data, Multimedia databases. Design issues of spatial, temporal and multimedia databases.

**Unit 5. Cloud Databases** **7 Hrs.**

Introduction, Architecture, Data Models, NoSQL databases : Apache Cassandra, CouchDB and MongoDB, Comparison of Relational databases and Cloud databases, Challenges to develop Cloud Databases.

**Unit 6. Graph Databases** **6 Hrs**

Introduction, options for storing connected data, data modeling with graphs, building graph database application, graphs in the real world, graph database internals.

## Reference Books


1 Thomas Connolly, Carolyn Begg "Database Systems: A Practical Approach to Design, Implementation and Management", Pearson, 4th Edition. 2012

2 Silberschatz, Korth & Sudarshan, "Database System Concepts", MGH. 6th Edition 2011

3 Fundamentals of Database Systems - Elmasri and Navathe [4e], Pearson Education3. Database Systems, Design, Implementation and Management - Coronel-Morris- Rob)

4 Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design Implementation and Management", Third Edition, Pearson Education, 2007.

5 Ramakrishnan & Gehrke, "Database Management System.", MGH. 3rd Edition 2003

6 Jeffrey A. Hoffer, Mary B. Prescott, Fred R. McFadden, "Modern Database Management.", Pearson, 6th Edition 2002

7 Rob & Coronel, "Database Systems – Design, Implementation & Management.", Thomson, 5th Edition 2003

8 Oracle 11g / IBM DB2 9.7 manuals

# PCC-CSE-103 Advanced Algorithm

**Theory :** 3 Hr/Week
**Practical:** 2 Hr/Week
**Marks :** 100
**Term Work :** 25

## Course Objectives

1. To provide solution to problems using different algorithm design paradigms.
2. To analyze performance of algorithms and find lower bound.
3. To synthesize algorithms for different parallel architectures.

## Course Outcomes

At the end of the course students will be able to

1. Discover solution to problems using different algorithm design paradigms like Divide and Conquer and Greedy Approach.
2. Apply dynamic programming approach to tackle problems.
3. Analyze performance of algorithms using asymptotic analysis.
4. Find lower bound of complexity to solve different problems.
5. Synthesize efficient algorithms for different parallel architectures.

## Course Contents

**Unit 1.** **Introduction** **8 Hrs.**

Algorithm definition and specification, Performance analysis randomized algorithms, Divide and Conquer method, Binary search, Merge sort Quick sort and convex hull. Greedy method and Dynamic Programming General methods, Job sequencing with deadlines, Minimum cost spanning trees, Optimal merge patterns, All pairs shortest paths, Optimal binary search trees, Reliability design, Traveling salesman problem and flow shop scheduling.

**Unit 2.** **Lower bound Theory** **4 Hrs.**

Comparison trees, Oracles and adversary arguments, lower bounds through reductions.

**Unit 3.** **NP-Hard and NP- complete problems** **6 Hrs.**

Basic concepts, cook's theorem. NP –hard graph problems, NP-hard scheduling problems. NP-Hard code generation's problems.

**Unit 4.** **PARAM Algorithms** **6 Hrs.**

Introduction, computational model, Fundamental techniques and algorithms, Merging, lower bounds.

**Unit 5.** **Mesh Algorithms** **6 Hrs.**

Computational model, Packet routing fundamental algorithms, merging, computing the convex hull.

**Unit 6.** **Hypercube Algorithms** **6 Hrs**

Computational model, PPR routing fundamental algorithms, merging, computing the convex hull.

## Reference Books

1 "Fundamentals Of Computer Algorithms", Ellis Horowitz, Sartaj Sahni and Sanguthewar Rajasekaran (Galgotia Publications)

2 “Design And Analysis Of Algorithms”, Aho, Hopcraft & Ulman (Addison Wesley)

3 “Introduction to Algorithms”, Thomas H. Cormen, Charles S. Leiserson, Ronald L.Rivest and Clifford Stein (PHI), 2nd Edition.

4 “Randomized Algorithms”, Rajeev Motwani and Prabhakar Raghavan (CambridgeUniversity Press)

# PCE-CSE-101 Advanced Network Protocol

**Theory :** 3 Hr/Week **Marks :** 100
**Practical:** -- Hr/Week **Term Work :** 25

## Course Objectives

1. To understand network protocols, architectures and applications
2. To study the functionality of various layers of the OSI model / TCP/IP model and understand the interactions between them
3. To Study the various Routing protocols in the Internet and the working of ATM.
4. To understand the networking management principals

## Course Outcomes

At the end of the course students will be able to

1. Describe the functionality of various layers of the OSI model, TCP/IP protocol suite and ATM network.
2. Describe various Routing protocols in the Internet and networking management principals.
3. Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.
4. Implement, evaluate, and improve networking concepts, techniques, and algorithms through projects.

## Course Contents

**Unit 1.** **Advanced Networks Concepts**: **6 Hrs.**

VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN. MPLS operation, Routing, Tunneling and use of FEC, Traffic Engineering, and MPLS based VPN, overlay networksP2P connections.-IPv4 and IPV6 addressing

**Unit 2.** **The WAN Protocol** **6 Hrs.**

Introducing ATM Technology, basic concepts of ATM Networking, Exploring the B-ISDN reference model, ATM Physical Layer, ATM Layer, ATM Adaptation Layer, Frame Relay, X.25, LAPB, HDLC, SDLC, PPP.

**Unit 3.** **Routing Protocols** **7 Hrs.**

Intra and interdomain routing; Unicast Routing Protocols: RIP, OSPF, BGP; Multicast Routing Protocols: MOSPF, DVMRP. Drawbacks of traditional routing methods, Idea of TE, TE and Different Traffic classes. IP over ATM, Multi protocol Label switching (MPLS)

**Unit 4.** **Transport Layer Protocols** **7 Hrs.**

The Transport service primitives
**UDP:** Process to Process communication, User Datagram Format, Operation and uses of UDP.
**TCP:** TCP Services and Features, TCP segment format, TCP Connections, Flow and error control in TCP, TCP Timers.
**Berkeley Sockets:** Socket Addresses, Elementary Socket system calls byte ordering and address conversion routines, connectionless iterative server,

Connection Oriented concurrent server, TCP and UDP Client server Programs

**Unit 5.** **Network Management Tools and Systems** **6 Hrs.**

Network Management Tools, Network Statistics Measurement Systems, History of Enterprise Management, Network Management systems, Commercial Network management Systems, System Management and Enterprise Management Solutions SNMP: Concept, Management components, SMI, MIB, SNMP format, Messages.

**Unit 6.** **Traffic Engineering and Capacity Planning** **6 Hrs**

Traffic Engineering Basics: Requirement, Traffic sizing, characteristics, Protocols, Time Delay considerations, Connectivity, Reliability, Availability and Maintainability, Throughput calculations.

## Text Books


1 TCP/IP Protocol Suite, (B. A. Forouzan), Tata McGraw Hill

2 Advanced Computer Network- Dayanand Ambawade, Dr.Deven shah, Prof.MahendraMehra-Wiley India

3 Computer Networks, 5e (5th Edition) by Andrew Tanenbaum.


## Reference Books


1 CCNA Intro – Study Guide – Todd Lammle, Sybex

2 Computer Networks: Principles, Technologies and Protocols for Network design, (N. Olifer, V. Olifer), Wiley India.

3 TCP/IP Volume 1, 2, 3, (W. Richard Stevens), Addison Wesley

4 TCP/IP Volume I and II, (D. E. Comer), Pearson Education.

5 High Performance Communication Networks, (J. Walrand, P. Varaiya), Morgan Kaufmann.

6 Computer Networks, (A. S. Tanenbaum), Pearson Education, Fourth Edition.

7 High-Speed Networks and Internets, Performance and Quality of Service, - William Stallings, Pearson Education

8 Larry L. Peterson, Bruce S ,"Computer Networks: A Systems Approach", 4th edition, Davie Publisher

9 Network Management: Principles and Practice; by Mani Subramanian; Addison Wesley; 2000; ISBN 0-201-35742-

10 The Cuckoo's Egg : Tracking a Spy Through the Maze of Computer Espionage;by Clifford Stoll;Pocket Books;ISBN 0671726889

11 A. Clemm, "Network Management Fundamentals", Cisco Press, ISBN-13 978-1-58720-137-0

# PCE-CSE-101 Adhoc Wireless Networks

**Theory :** 3 Hr/Week **Marks :** 100
**Practical:** -- Hr/Week **Term Work :** 25

## Course Objectives

1. To introduce Cellular and Ad Hoc wireless networks
2. To introduce routing protocol in Ad Hoc wireless networks
3. To introduce security in Ad Hoc wireless networks
4. To introduce QoS in Ad Hoc wireless networks

## Course Outcomes

At the end of the course students will be able to

1. Identify issues in Ad Hoc wireless networks
2. Identify design issues and Classify MAC protocols in Ad Hoc wireless networks
3. Identify design issues and Classify routing protocols in Ad Hoc wireless networks
4. Identify design issues and explain operation of multicast routing protocols in Ad Hoc wireless networks
5. Explain security aspects in Ad Hoc wireless networks
6. Classify QoS solutions and Energy Management techniques in Ad Hoc wireless networks

## Course Contents

**Unit 1.** **Introduction** **7 Hrs.**
Cellular and Ad Hoc wireless networks, Applications, Issues in Ad Hoc wireless networks.
**MAC Protocols for ad hoc wireless networks** – Introduction, Issues in designing MAC protocol, Design goals of MAC protocol, Classification of MAC protocols, Contention based protocols.

**Unit 2.** **Routing protocols for ad hoc wireless networks** **5 Hrs.**
Introduction, Issues in designing a routing protocol for ad hoc wireless networks, Classification of routing protocols, Table driven, on-demand Hybrid routing protocols.

**Unit 3.** **Multicast Routing in Ad hoc wireless networks** **6 Hrs.**
Introduction, Issues in designing a multicast routing protocol, Operation of multicast routing protocols, An architecture reference model for multicast routing protocols, Classification of multicast routing protocols, Tree-based, Mesh-based multicast routing protocols

**Unit 4.** **Transport layer and security protocols for ad hoc wireless networks** **8 Hrs.**
Introduction, Design issues and goals, Classification of transport layer solutions, TCP over ad hoc wireless networks, Security in ad hoc wireless networks, Network security requirements, Issues and challenges in security provisioning, Network security attacks, Key management, Secure routing.

**Unit 5.** **Quality of service** – Introduction, Issues and challenges, Classification of QoS solutions, MAC layer solutions, Network layer solutions, QoS framework. **5 Hrs**

**Unit 6.** **Energy management** – Introduction, Need, Classification of energy management schemes, Battery Management, Transmission Power Management, **5 Hrs**

System Power Management schemes.

**Reference Books**


1. Ad Hoc wireless Networks – Architecture and Protocols by C.S.R.Murthy& B.S. Manoj, Pearson Education
2. Ad Hoc Wireless Networks – A communication Theoretic perspective by O.K.Tonguz&G.Ferrari, Wiley India.
3. Ad Hoc Mobile Wireless Networks – Protocols and Systems by C. K. Toh (Pearson Education)
4. Ad Hoc Networking by Charles E. Perkins (Pearson Education)
5. Introduction to Wireless and Mobile Systems, 2nd Edition, by Dharma Prakash Agrawal & Qing-An Zeng (CENGAGE Learning)

# PCE-CSE-101 Pervasive Computing

**Theory :** 3 Hr/Week
**Practical:** -- Hr/Week
**Marks :** 100
**Term Work :** 25

## Course Objectives

1. To introduce pervasive computing abilities.
2. To introduce smart devices and environment required for pervasive computing.
3. To introduce Human Computer Interaction in context of Pervasive Computing.
4. To introduce handling of smart devices in context of Pervasive Computing.

## Course Outcomes:

1. To model Key Ubiquitous/Pervasive Computing Properties
2. To understand working of smart environment and smart devices.
3. To understand working of Human Computer Interaction in context of Pervasive Computing.
4. To understand management of smart devices in context of Pervasive Computing.

## Course Contents

**Unit 1.** **Introduction to Pervasive Computing** **5 Hrs.**
Concept of Pervasive Computing, Modeling the Key Ubiquitous/Pervasive Computing Properties, Mobile Adaptive Computing, Mobility Management and Caching

**Unit 2.** **Pervasive Computing Devices** **6 Hrs.**
Smart Environment : CPI and CCI ,Smart Devices : Application and Requirements , Ubiquitous Networks of Devices: CCI, Human to Human Interaction (HHI) Applications

**Unit 3.** **Human Computer Interaction** **6Hrs.**
Explicit HCI, Implicit HCI, User Interface and Interaction for four hand-held widely used devices, Hidden UI via basic smart devices, Hidden UI via wearable and Implanted devices, Human centered design, user models

**Unit 4.** **Management of Smart Devices** **8Hrs.**
Managing Smart Devices in Virtual Environments, Process and Application Management, Network Oriented Management, Monitoring and Accounting, Configuration Management, Fault Management, Performance Management, Service Oriented Computer Management, Managing Smart Devices in Physical Environments

**Unit 5.** **Middleware for Pervasive** **5 Hrs**
Adaptive middleware, Context aware middleware, Mobile middleware, Service Discovery, Mobile Agents.

**Unit 6.** **Challenges and Outlook** **6 Hrs**
Overview of challenges, smart devices, Smart Interaction, Smart physical environment device interaction, Smart human-device interaction, Human Intelligence versus machine intelligence, social issues.

**Reference Books**


1. Stefan Poslad, Ubiquitous Computing, Smart devices, environment and interaction, Wiley.

2. Frank Adelstein, Sandeep Gupta, Golden Richard III, Loren Schwiebert, Fundamentals of Mobile and Pervasive Computing, Tata McGraw Hills

3. Jochen Burkhardt, Horst Henn, Stefan Hepper, Klaus Rindtorff, Thomas Schaeck, Pervasive Computing, Pearson, Eighteenth Impression, 2014.

4. BoS Content: Books, Course Notes, Digital contents, Blogs developed by the BoS for bridging the gaps in the syllabus, problem solving approaches and advances in the course

# PCE-CSE-102 Cloud and Virtualization

**Theory :** 3 Hr/Week **Marks :** 100
**Practical:** 2 Hr/Week **Term Work :** 25

## Course Objectives

1. To understand the need of Cloud and virtualization
2. To understand the concepts of cloud computing
3. To understand the security issues in cloud computing.
4. To understand the concepts of virtualization, its types and virtual machines.
5. To understand the practical aspects of virtualization solutions.

## Course Outcomes : At the end of the course student will be able to

1. Explain basic concepts of cloud computing
2. Describe virtualization concepts related with cloud
3. Describe security related aspects of cloud computing
4. Explain virtualization in different scenarios

## Course Contents

**Unit 1.** **Introduction to Cloud** **4 Hrs.**

Getting to know the Cloud, Cloud and other similar configurations, Components of Cloud Computing, Cloud Types and Models: Private Cloud**,** Community Cloud, Public Cloud, Hybrid Clouds.

**Unit 2.** **Virtualization** **5 Hrs.**

Introduction and benefits, Implementation Levels of Virtualization, Virtualization at the OS Level, Virtualization Structure, Virtualization Mechanism, Open Source Virtualization Technology, Xen Virtualization Architecture, Binary Translation with Full Virtualization, Paravirtualization, Virtualization of CPU, Memory and I/O Devices.

**Unit 3.** **Cloud Computing Services and Data Security in Cloud** **6 Hrs.**

Explicit HCI, Implicit HCI, User Interface and Interaction for four hand-held widely used devices, Hidden UI via basic smart devices, Hidden UI via wearable and Implanted devices, Human centered design, user models

**Unit 4.** **Overview of Virtualization** **7 Hrs.**

Basics of Virtualization – Types of Virtualization Techniques – Merits and demerits of Virtualization –Full Vs Para-virtualization – Virtual Machine Monitor/Hypervisor - Virtual Machine Basics – Taxonomyof Virtual machines – Process Vs System Virtual Machines – Emulation: Interpretation and Binary Translation - HLL Virtual Machines

**Unit 5.** **Server and Network Virtualization** **7 Hrs**

Server Virtualization: Virtual Hardware Overview - Server Consolidation – Partitioning Techniques -Uses of Virtual server Consolidation – Server Virtualization Platforms, Network Virtualization: Design of Scalable Enterprise Networks – Layer2 Virtualization – VLAN - VFI - Layer 3 Virtualization –VRF - Virtual Firewall Contexts - Network Device Virtualization - Data- Path Virtualization – Routing Protocols.

**Unit 6.** **Storage, Desktop and Application Virtualization** **7 Hrs**

Storage Virtualization: Hardware Devices – SAN backup and recovery techniques – RAID –
Classical Storage Model – SNIA Shared Storage Model – Virtual Storage: File System Level and
Block Level, Desktop Virtualization: Concepts - Desktop Management Issues - Potential Desktop Virtualization Scenarios - Desktop Virtualization Infrastructures, Application Virtualization: Concepts- Application Management Issues - Redesign Application Management – Application Migration

**Reference Books**


1. Cloud Computing Black Book- Jayaswal, Kallakurchi, Houde, Shah, Dreamtech Press.
2. Cloud Computing: Principles and Paradigms – Buyya, Broburg, Goscinski.
3. Cloud Computing for Dummies – Judith Hurwitz.
4. James E. Smith, Ravi Nair, - Virtual Machines: Versatile Platforms for Systems and Processes, Elsevier/Morgan Kaufmann, 2005.
5. David Marshall, Wade A. Reynolds, - Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach Publications, 2006.
6. Kumar Reddy, Victor Moreno, - Network virtualization, Cisco Press, July, 2006.
7. Chris Wolf, Erick M. Halter, - Virtualization: From the Desktop to the Enterprise, APress 2005.
8. Danielle Ruest, Nelson Ruest - Virtualization: A Beginner's Guide, TMH, 2009
9. Kenneth Hess , Amy Newman: Practical Virtualization Solutions: Virtualization from the Trenches Prentice Hall 2010


**Guidelines for Tutorials:**

(Minimum 4 Tutorials from unit 1 to 3 and 4 from Unit 4 to 6.)

# PCE-CSE-102 High Performance Computer Architectures

**Theory :** 3 Hr/Week
**Practical:** 2 Hr/Week

**Marks :** 100
**Term Work :** 25

**Course Objectives**

1. Introduce types of computer architectures.
2. Introduce concepts of Memory Hierarchy and latency.
3. Instruction Level Parallelism.
4. Study of Data-Level Parallelism in Vector, SIMD, and GPU Architectures
5. Study of Warehouse-Scale Computers.

**Course Outcomes:**

At the end of the course students will be able to

1. Describe different design techniques with its analysis
2. Explain different memory hierarchy design
3. Describe instruction level and thread level parallelism
4. Explain data level parallelism with different architectures

**Course Contents**

**Unit 1.** **Fundamentals of Quantitative Design and Analysis** **5 Hrs**

Introduction, Classes of Computers, Defining Computer Architecture, Trends in Technology, Trends in Power and Energy in Integrated Circuits, Trends in Cost, Dependability Measuring, Reporting, and Summarizing Performance Quantitative Principles of Computer Design Putting It All Together: Performance, Price, and Power, Fallacies and Pitfalls.

**Unit 2.** **Memory Hierarchy Design** **6 Hrs.**

Introduction, Ten Advanced Optimizations of Cache Performance, Memory Technology and Optimizations, Protection: Virtual Memory and Virtua Machines, Crosscutting Issues: The Design of Memory Hierarchies, Putting I All Together: Memory Hierarchies in the ARM Cortex-A8 and Intel Core I7 Fallacies and Pitfalls.

**Unit 3.** **Instruction-Level Parallelism and Its Exploitation** **10 Hrs.**

Instruction-Level Parallelism: Concepts and Challenges, Basic Compiler Techniques for Exposing ILP , Reducing Branch Costs with Advanced Branch Prediction, Overcoming Data Hazards with Dynamic Scheduling ,Dynamic Scheduling: Examples and the Algorithm , Hardware-Based Speculation, Exploiting ILP Using Multiple Issue and Static Scheduling , Exploiting ILP Using Dynamic Scheduling, Multiple Issue, and Speculation , Advanced Techniques for Instruction Delivery and Speculation ,Studies of the Limitations of ILP Cross-Cutting Issues: ILP Approaches and the Memory System, Multithreading: Exploiting Thread-Level Parallelism to Improve Uniprocessor Throughput , Putting It All Together: The Intel Core i7 and ARM Cortex-A8 233 Fallacies and Pitfalls.

**Unit 4.** **Data-Level Parallelism in Vector, SIMD, and GPU Architecture** **7 Hrs.**

Introduction, Vector Architecture , SIMD Instruction Set Extensions for Multimedia , Graphics Processing Units Detecting and Enhancing Loop-Level Parallelism , Crosscutting Issues , Putting It All Together: Mobile versus Server GPUs and Tesla versus Core i7, Fallacies and Pitfalls.

**Unit 5.** **Thread-Level Parallelism** **7 Hrs.**

Introduction, Centralized Shared-Memory Architectures, Performance of Symmetric Shared-Memory Multiprocessors, Distributed Shared-Memory and Directory-Based Coherence, Synchronization, Models of Memory Consistency, Crosscutting Issues, Putting It All Together: Multicore Processors and Their Performance, Fallacies and Pitfalls

**Unit 6.** **Warehouse-Scale Computers to Exploit Request-Level and Data-Level Parallelism** **8 Hrs**

Introduction, Programming Models and Workloads for
Warehouse-Scale Computers, Computer Architecture of Warehouse-Scale Computers, Physical Infrastructure and Costs of Warehouse-Scale Computers, Cloud Computing: The Return of Utility Computing, Crosscutting Issues, Putting It All Together: A Google Warehouse-Scale Computer Fallacies and Pitfalls.

**Text Books**

1 Computer Architecture -A Quantitative Approach,FifthEdition by John L. Hennessy and David A. Patterson published by Elsevier.

**Reference Books**

1 M.R. Bhujade, “Parallel Computing”, 2nd edition, New Age International Publishers 2009

# PCE-CSE-102 Advanced Operating Systems

**Theory :** 3 Hr/Week
**Practical:** 2 Hr/Week

**Marks :** 100
**Term Work :** 25

## Course Objectives

6. To deliver different components of advanced and distribute operating system.
7. To provide knowledge of issues involved in virtualization, cloud and security aspects of OS.
8. To induce steps involved in designing operating systems and distributed systems.

## Course Outcomes:

At the end of the course students will be able to

1. Explain the advances in operating systems and characteristics of environment in which they are used.
2. Apply the communication techniques in distributed operating systems and implement and analyze techniques such as remote procedures, scheduling in distributed systems.
3. Design and implement different control algorithms in distributed mutual exclusion, distributed deadlocks, election algorithms etc.

## Course Contents

**Unit 1.** **Multiple E Processor Systems** **7 Hrs**

MULTIPROCESSORS- Multiprocessor Hardware, Multiprocessor Operating System Types, Multiprocessor Synchronization, Multiprocessor Scheduling, MULTICOMPUTER S - Multicomputer Hardware, Low-Level Communication Software, User-Level Communication Software, Remote Procedure Call, Distributed Shared Memory, Multicomputer Scheduling, Load Balancing

**Unit 2.** **Distributed Operating Systems** **7 Hrs.**

Features, Nodes of Distributed systems, Integrating Operation of Nodes of Distributed system, Reliable Interprocess Communication, Distributed Computation Paradigms, Networking, Models of Distributed System, Design Issues.

Theoretical Issues in Distributed Systems – Notions of Time and State, States and Events, Time, Clocks and Event Precedences, Recording the state of a distributed System.

**Unit 3.** **Distributed Control Algorithms** **6 Hrs.**

Operation of Distributed Control Algorithms, Correctness, Distributed Mutual Exclusion, Distributed Deadlock Handling, Distributed Scheduling Algorithms, Distributed Termination Detection, Election Algorithms, Practical Issues in using Distributed Control Algorithms

Recovery and Fault Tolerance – Faults, failures and recovery, Byzantine Faults and Agreement Protocols, Recovery, Fault Tolerance Techniques, Resiliency.

**Unit 4.** **Distributed File Systems** **7 Hrs.**

Design issues, Transparency, Semantics of file sharing, fault tolerance, DFS performance, Case studies – Sun Network File System, Andrew and Coda File System, GPFS, Windows.

Distributed System Security – Issues in Distributed system security, Message security, Authentication of Data and Messages, Third party authentication.

**Unit 5.** **Virtualization** **6 Hrs.**

Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples

**Unit 6. Cloud Computing Architecture** **7 Hrs**

Introduction, The cloud reference model – Architecture, Infrastructure- and hardware-as-a-service, Platform as a service, Software as a service, Types of cloud, Economics of the cloud, Open challenges

Aneka - Framework overview, Anatomy of the Aneka container, Building Aneka clouds, Cloud programming and management - Aneka SDK, Management tools.

## Text Books


1 Chapter 1 from Modern Operating Systems by Andrew S Tanenbaum, Pearson, 4th Edition

2 Chapter 2 to 4 from Operating Systems -A concept based approach 3rd Edition by D. M. Dhamdhere, McGraw Hill publication.

3 Chapter 5 to 6 from Rajkumar Buyya, Christian Vecchieola, S. Thamarai Selvi, "Mastering Cloud Computing", (McGrawHill)


## Reference Books


1 Operating System Concepts, written by Peter B. Galvin, Greg Gagne and Abraham Silberschatz, John Wiley, 8th Edition.2011.

2 P. K. Sinha, "Distributed Operating Systems Concepts and Design", PHI.

# PW-CSE-101 Research Methodology

**Practical:** 2 Hr/Week **Term Work :** 25

**Course Objectives**

1. To familiarise students with the dimensions and methods of research.
2. To familiarise students with different methods of data collection.
3. Give students an insight into the steps to be followed in doing a research.

**Course Outcomes: At the end of the course student will be able to**

1. Explain different dimensions and methods of research
2. Use appropriate method of data collection.

**Course Contents**

**Unit 1** **Fundamentals of Research** **4 Hrs**

Introduction, Concepts of Research, Research Process, Creativity in Research, Ethics in Research, Managers and Research

**Unit 2.** **Research Problem** **4 Hrs.**

Research Problem Introduction, Concept of Research Problem, Conditions and Components of Research Problem

**4 Hrs.**

**Unit 3.** **Research Design**

Research Design Introduction, Concept of Research Design, Need and Features of Research Design, Components of Research Design, Types of Research Design

**5 Hrs.**

**Unit 4.** **Methods of Data Collection**

Methods of Data Collection Concepts of Data Collection, Types of Data, Methods of Primary Data Collection, Some other Methods of Primary Data Collection, Methods of Secondary Data Collection, Selecting an Appropriate Method of Data Collection

**5 Hrs**

**Unit 5.** **Data Processing and Analysis**

Data Processing and Analysis Introduction, Concepts of Data Processing, Concept of Data Analysis, Measures of Central Tendency, Measures of Dispersion, Measures of Skewness, Measures of Relationship, Other Statistical Measures used in Research

**4 Hrs**

**Unit 6.** **Computer Application in Research Methodology**

Computer Application in Research Methodology Introduction, Computer Application in Research Methodology, SPSS Software, Descriptive Statistics, Bivariate Statistics, Regression Analysis

**Reference Books**

1. Research Methodology by G.C.Ramamurthy & Kogent Learning Solutions Inc. (dreamtech press)

# Semester -II
# PCC-CSE-201- Systems and Information Security

**Theory:** 3 Hr/Week
**Tutorial:**1 Hr/Week
**Marks:** 100
**Term Work :** 25

**Course Objectives**

1. To learn Fundamental Concepts of Cryptography and Network Security
2. To introduce Definition and Types of Encryption and Decryption Techniques
3. To expose students to Need and use of authentication, Digital Signatures in security.
4. To learn Network Security for IP, E-Mail, Web, intrusion detection systems

**Course Outcomes**

At the end of the course students will be able to

1. Describe basic terminology in cryptography, and classical cryptosystems.
2. Explain modern cryptosystems.
3. Explain security policies such as authentication, integrity and confidentiality.
4. Explain network and Web security protocols.

## Course Contents

**Unit 1. Introduction** **6 Hrs.**

Basic Cryptography and Cipher Techniques Classical crypto system, Stream & block ciphers, Introduction to finite fields, DES, AES, RC5, Differential and Liner Cryptanalysis

**Unit 2. Asymmetric key cryptography** **7 Hrs.**

Introduction to number theory, RSA, key management, Diffi-Hellman key exchange elliptic curve arithmetic, elliptic curve cryptography, Zero knowledge proof systems.

**Unit 3. Authentication:** **6 Hrs.**

Authentication requirements, Authentication Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and MACS, Digital Signatures, Authentication Protocols, Digital Signature Standard

**Unit 4.** **Network Security:** **7 Hrs.**

Electronic Mail Security - Pretty Good Privacy, S/MIME, IP Security – IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating security Payload

**Unit 5.** **Web Security:** **5 Hrs.**

Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction

**Unit 6.** **System Security:** **5 Hrs**

Malicious Logic and System Security Introduction, computer viruses, worms, Intruders - Intruders, Intruder detection, Password Management, Malicious Software - Viruses and Related Threats, Virus Countermeasures, Firewall - Firewall Design Principles, Trusted systems, recent trends in IP security- case study, legal issues, tools used to detect and prevent attacks

## Reference Books


1 “Cryptography and Network Security Principles and Practices”: Williams Stallings (LPE).

2 "Handbook of Applied Cryptography": Menezes, A. J., P. C. Van Oorschot, and S. A. Vanstone.

3 "Applied Cryptography: Protocols & Algorithms": Schneier, Bruce.

4 IP security-Case study: tools from appropriate white papers or journal papers from internet

# PCC-CSE-202Machine Learning

**Theory:** 3 Hr/Week
**Practical:**2Hrs/Week

**Marks:** 100
**Term Work :** 25

## Course Objectives

1. To understand Human learning aspects and represent using mathematical model
2. To understand primitives in learning process and implement using programming
3. To understand mathematical modeling for solving problems

## Course Outcomes

At the end of the course students will be able to

1. Explain machine learning concepts.
2. Analyse the Machine learning model and apply to solve societal problems
3. Design solution using machine learning techniques.

## Course Contents

**Unit 1.** **Introduction** **05 Hrs.**

Definition, Terminology, Types of learning, Machine Learning Problem categories, Machinelearning architecture, process, Lifecycle, Goals and applications of machine learning, Performance measures, tools and framework, datavisualization.

**Unit 2.** **Regression** **08 Hrs.**

Simple regression – hypothesis, cost function, parameter learning with gradient descent, learningrate, Gradient Descent for linear regression, examples, simple regression in matrix form.Multivariate Linear Regression – multiple features, hypothesis functions, Gradient Descent formultiple variables, Feature scaling, polynomial regression

**Unit 3.** **Classification- logistic regression** **06 Hrs.**

Definition, logistic regression – hypothesis representation, decision boundary, cost function,gradient descent for logistic regression. multiclass classification, Regularization - Overfitting&Underfitting, cost function, Regularized Linear Regression, Regularized Logistic Regression

| | | |
|---|---|---|
| **Unit 4.** | **Artificial Neural Networks**<br>Neurons and biological motivation. Model Representation, Linear threshold units. Perceptrons: representational limitation and gradient descent training. Hypothesis for neuron, cost function,solution of a problem using single neuron.Multiclass classification with neural network. Backpropagation, Hidden layers and constructing intermediate, distributed representations. Overfitting, learning network structure, recurrent networks. | **08 Hrs.** |
| **Unit 5.** | **Classification- Decision trees and Naïve Bayes**<br>Decision trees: definition, terminology, the need, advantages, and limitations. constructing andunderstanding Decision trees, common problems with Decision trees, Decision tree algorithms,random forest, examples. Conditional probability and Naïve Bayes Classifier Instance-basedclassifier – K- Nearest Neighbour Classifier | **08 Hrs.** |
| **Unit 6.** | **Unsupervised learning**<br>Clustering, K Means clustering, Hierarchical clustering, Association Rule Mining | **05Hrs** |

## Reference Books


1. Machine Learning with Python- an approach to applied ML, by AbhishekVijayvargia, BPB publications
2. Practical Machine Learning by SunilaGollapudiPackt Publishing Ltd.
3. Machine Learning by Tom M. Mitchell, McGraw Hill Education; First edition
4. Machine Learning for dummies John Paul Muller, Willey Publication
5. EthemAlpaydin : Introduction to Machine Learning, PHI 2nd Edition-2013

# PCE-CSE-201Data Analytics

**Lectures: 3 hrs / week** **Marks: 100 Marks**

**Practical: 2 hrs/week** **Term Work: 25 Marks**

**Course Objectives:**

1. To study data mining techniques

3. To study the basics of web mining and social network Analysis.

4. Understand the concepts of Big data and challenges in processing Big Data

5. Understand Hadoop architecture and eco-system

**Course Outcomes:**

1. Students will be able to explain fundamentals of Data analysis using data mining, data preparation and exploration, Business Intelligence.

2. Student will be able to explain Classification, clustering with respect to data mining.

3. Student will be able to describe association rule mining, web miningwith respect to data mining.

4. Students will be able to explain fundamentals related to Hadoop and work with Hadoop and work with Hadoop ecosystems such as pig and hive.

5. Student will be able to describe Social Network Analysiswith respect to data analytics.

**Course Content** .

**Unit 1: Business Intelligence Fundamentals (5hrs)**

Components of Decision making process, Business intelligence, Decision Support Systems, Data ware-housing. Data analysis and exploration, Mathematical models for decision making, data preparation, data exploration, Data Mining, Regression and Correlation, Similarity Measures.

**Unit 2: Introduction of Big data and Hadoop Echo system (7hrs)**

Big data definition, Elements of Big data, Big data analytics, Big Data Stack, Virtualization and Big data, virtualization approaches, Hadoop Ecosystem, Hadoop Distributed file system(HDFS, MapReduce, Hadoop YARN, Hbase, Hive, Pig and Pig latin, Sqoop, ZooKeeper, Flume, Oozie

**Unit 3: Classification (7hrs)**

Introduction to Classification, Issues in Classification, Statistical Based Algorithms, Bayesian Classification, Distance Based Algorithms, Simple Approach, K Nearest Neighbors, Decision Tree Based Algorithms, ID3, C4.5, CART, Rule Based Algorithms, Generating Rules from a DT, Generating Rules from Neural Networks.

**Unit 4. Clustering (7hrs)**

Introduction to clustering, Similarity and Distance Measures for clustering, Outliers, Hierarchical Algorithms, Agglomerative Algorithms, Divisive Clustering, Partitional Algorithms, Minimum Spanning Tree, Squared Error Clustering Algorithm, K-Means Clustering, Nearest Neighbor Algorithm, Clustering Large Database, BIRCH, DBSCAN, CURE Algorithm.

**Unit 5. Association Rules (7hrs)**

Introduction toAssociation Rule Mining, Large Item sets, Basic Algorithms, Apriori Algorithm, Sampling Algorithm, Partitioning, Parallel and Distributed Algorithm, Data Parallelism, Task Parallelism, Comparing Approaches, Incremental Rules, Advanced, Association Rule Techniques, Generalized Association Rules, Multiple Level Association Rules,

**Unit 6. Web Mining (7hrs)**

Introduction to Web Mining, Web Content Mining, Web Structure Mining, Web Usage Mining, Preprocessing, Social Network Analysis, Characteristics of Social Networks, Link Mining: Tasks and Challenges, Mining on Social Networks.

**Text Books:**

1. Data Mining Introductory and Advanced Topics - Margaret H. Dunham(Unit 1, 3,4,5,6)
2. Business Intelligence - Data Mining and optimization for Decision Making- Carlo Vercellis- Wiley Publications.(Unit 1)
3. Data Mining: Concepts and Techniques Second Edition- Jiawei Han and MichelineKamber- Morgan, KaufMan Publisher.(Unit 6)
4. Big Data and Analytics- Seema Acharya and SubhashiniChellappan- Wiley Publications(Unit 2)

**Reference Books:**

1. Data Mining Practical Machine Learning Tools and Techniques - Ian H. Witten, Eibe Frank
2. Mastering Data Mining by Michael J.A. Berry & G.S. Linoff (Wiley Student Edition)
3. Big Data (Black Book)- DT Editorial Services- Dreamtech Press

# PCE-CSE-201 Data Warehousing and Data Mining

**Lectures: 3 hr / week** **Marks: 100 Marks**

**Practical: 2 hrs/week** **Term Work: 25 Marks**

**Course Objectives :**

1. To perceive the basic concepts of Data Warehousing, Data mining – its architecture and implementations.
2. To implement and analyze the datawarehousingprocess and data miningalgorithms.
3. To evaluate the different data warehousing anddatamining tools.

**Course Outcomes**:

1. Student will understand fundamentals of data warehousing and data mining.
2. Student will be able to illustrate data warehousing process and data mining algorithms.
3. Student will be able to utilize different data warehousing and data mining tools.

## Course Content

**Unit 1:Data warehousing (DW) Overview and Concepts** **6hrs**

The compelling need for data warehousing:Need for strategic information, failures of past DSS, operational versus DSS, DW-only viable solution.
Data warehouse building blocks: Defining features, DW and data marts, understanding DW architecture, distinguishing characteristics, architectural framework, Technical architecture, architectural types, metadata in DW.

**Unit 2 :Building the Data Warehouse :** **7hrs**

Principles of Dimensional Modeling:From requirements to data design, the star schema, star schema keys, advantages of star schema, star schema examples, snowflake schema.
Data Extraction, Transformation and Loading (ETL):ETL overview, ETL requirements and steps, data extraction, data transformation, data loading, ETL summary.

**Unit 3: Data Mining** **6hrs**

Introduction : Basic data mining tasks, data mining knowlede discovery in databases, data mining issues, data mining metrics, data mining from database perspective, future.
Classification: Issues in classification, stat tical based algorithms, distance ased algorithms, neural network based algorithm

**Unit 4:Clustering** **6hrs**

Introduction, similarity and distance measures, hierarchical algorithms, partition algorithms, clustering large databases

**Unit 5:Association rules** **7hrs**

Introduction, item sets, basic algorithms, parallel and distributed algorithm, comparing approaches, measure the quality of rules

**Unit 6:Web Mining** **6hrs**

Introduction, web content mining, web structure mining, web usage mining

## Textbook:


1. Data Warehousing - Fundamentals for IT Professional: PaulrajPonniah 2nd Edition.Wiley
2. Data Mining - Introductory and Advanced Topics : Dunham, Margaret H, PrenticeHall.


## References:


1. Data Mining - Concepts & Techniques: Jiawei Han &MichelineKamber, MorganKaufmann.
2. Building the Data Warehouse- W. H. Inmon, Wiley Dreamtech India Pvt.Ltd...
3. The Data Warehouse Life cycle Tool kit – RALPH KIMBALL WILEY STUDENTEDITION

# PCE-CSE-201 Business Analytics

**Business Analytics**

**Lectures: 3 hr / week** **Marks: 100 Marks**

**Practical: 2 hrs/week** **Term Work: 25 Marks**

## Course Objectives

1. To learn basic understanding of business analytics and its role within an organization.
2. To provide sound domain knowledge of business analytics and its critical concepts
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making
4. To explore applications of analytics.

## Course Outcomes

At the end of the course students will be able to

1. Describe basic concepts of business analytics and its role within an organization.
2. Describe types of digital data.
3. Analyse need and features of Business Intelligence.
4. Describe Data integration Technologies.
5. Describe multidimensional models.
6. Describe applications of Business analytics.

## Course Contents

**Unit 1. Introduction** **7 Hrs.**

Introduction to Business Analytics (BA) – Need, Components, Types and Techniques (Descriptive, Predictive and Prescriptive);Business Enterprise Organization, its functions and core business processes, Key Purpose of Using IT in Business; Information Users and Their Requirements. Framework for data-driven decision making.

**Unit 2. Digital data** **7 Hrs.**

Types of Digital Data – Definition, Sources, Storage and Characteristics of Structured, Unstructured and Semi-Structured Data; On Line Analytical Processing (OLAP) versus Online Transaction Processing (OLTP); Data Models for OLTP and OLAP

**Unit 3. Business Intelligence** **7 Hrs.**

Definitions and Examples in Business Intelligence, Data Mining, Big Data, Web and Social Media Analytics, Machine Learning, Data Science, Looking at Data from Various Perspectives of Managing Data; Need, Features and Use of Business Intelligence (BI); BI Component Framework; Business Intelligence versus Business Analytics.

**Unit 4. Basics of Data Integration** **7 Hrs.**

Need for Data warehouse, Definition of data warehouse, Data Mart, Goals of Data warehouse, Data sources, Extract ,Transform, Load, Data Integration and its technologies, Data quality, Data profiling.

**Unit 5. Multidimensional Data Modeling** **5 Hrs.**

Data modeling basics, Types of data model, Data Modelling techniques, Fact table, Dimension Table, Typical Dimensional models, Dimensional Modeling Lifecycle, Designing the dimensional Model.

**Unit 6. Applications of Analytics** **6Hrs**

Analytics in Business Support Functions – Human Capital Analytics, IT Analytics, Sales & Marketing Analytics; Analytics in Industries – Telecom, Retail, Healthcare; Analytical Application Development; Anatomy of Social Media Analytics, anatomy of recommendation system and its components

## Text Books

1 " Fundamentals of Business Analytics" R.N.Prasad and Seema Acharya

Wiley publisher2016.

2 "Business Analytics – The Science of Data-Driven Decision Making" U. Dinesh Kumar, Wiley publisher 2017

**Reference Books**


1 "Business Analytics", Sahil Raj, Cengage Learning.

2 "Business Analytics", James R Evans , Pearson Education Asia, 2nd Edition.

3 "Business Analytics for Managers: Taking Business Intelligence Beyond ", JesperThorlund&Gert H.N. Laursen,Wiley publication


## Practical: Business Analytics

**Term work:25**

**Practical:**2 Hr/Week **Credit:1**

**Practical Work:**

A] Write analysis of Case studies like: GoodLife HealthCare Group, GoodFood Restaurants Inc. TenToTen Retail Stores etc.

B] Students should select Small & Medium Enterprise and perform an exercise for application of the concepts learned under the domain of Business Analytics. Student has to prepare a report and give the presentation in the class.

# PCE-CSE-202 Deep Learning

**Lectures:** 3 hr / week **Marks:** 100 Marks

**Tutorial:**1 Hr/Week **Term Work:** 25 Marks

## Objectives

1. To understand basic concepts of Neural network and deep learning
2. To learn basic building blocks of deep networks
3. To learn major architectures of deep networks
4. To understand different way to tune of major deep networks

## Outcome:

At the end of this course student will be able to

1. Describe basic concepts of neural network and deep learning
2. Explain different architectures of deep learning
3. Describe different optimization techniques in deep learning
4. Design deep neural network according to given problem

### Course Content

**Unit 1: Foundations of Neural Network and Deep Learning (7hrs.)**

Neural Networks: The Biological Neuron, The Perceptron, Multilayer Feed-Forward Networks, Training Neural Networks: Backpropagation Learning, Activation Functions: Linear, Sigmoid, Tanh, Hard Tanh, Softmax, Rectified Linear, Loss Functions: Loss Function Notation, Loss Functions for Regression, Loss Functions for Classification, Loss Functions for Reconstruction, Hyperparameters: Learning Rate, Regularization, Momentum, Sparsity.

**Unit 2: Fundamentals of Deep Learning (6 hrs.)**

Defining Deep Learning: Deep Learning Definition, Common Architectural Principles of Deep Networks: Parameters, Layers, Activation Functions, Loss Functions, Optimization Algorithms, Hyperparameters Summary, Building Blocks of Deep Networks: RBMs, Autoencoders, VariationalAutoencoders.

**Unit 3: Major Architectures of Deep Networks-I (6 hrs.)**

Unsupervised Pre-Trained Networks: Deep Belief Networks, Generative Adversarial Networks, Convolutional Neural Networks (CNNs): Biological Inspiration, Intuition, CNN Architecture Overview, Input Layers, Convolutional Layers, Pooling Layers, Fully Connected Layers, Other Applications of CNNs, CNNs of Note, Summary

**Unit 4: Major Architectures of Deep Networks-II (5 hrs.)**

Recurrent Neural Networks, Modeling the Time Dimension, 3D Volumetric Input, Avoiding Markov Models, General Recurrent Neural Network Architecture, LSTM Networks, Domain-Specific Applications and Blended Networks, Recursive Neural Networks, Network Architecture, Varieties of Recursive Neural Networks, Applications of Recursive Neural Networks

**Unit 5: Tuning Deep Networks-I (8 hrs.)**

Basic Concepts in Tuning Deep Networks: An Intuition for Building Deep Networks, Building the Intuition as a Step-by-Step Process , Matching Input Data and Network Architectures: Summary, Relating Model Goal and Output Layers: Regression Model Output Layer, Classification Model Output Layer, Working with Layer Count, Parameter Count, and Memory: Feed-Forward Multilayer Neural Networks, Controlling Layer and Parameter Counts, Estimating Network Memory Requirements, Weight Initialization Strategies, Using Activation Functions: Summary Table for Activation Functions, Applying Loss Functions, Understanding Learning Rates: Using the Ratio of Updates-to-Parameters, Specific Recommendations for Learning Rates, How Sparsity Affects Learning

**Unit 6: Tuning Deep Networks-II (8 hrs.)**

Applying Methods of Optimization , SGD Best Practices, Using Parallelization and GPUs for Faster Training , Online Learning and Parallel Iterative Algorithms, Parallelizing SGD in DL4J, GPUs, Controlling Epochs and Mini-Batch Size, Understanding Mini-Batch Size Trade-Offs, How to Use Regularization, Priors as Regularizes, Max-Norm Regularization, Dropout, Other Regularization Topics , Working with Class Imbalance, Methods for Sampling Classes, Weighted Loss Functions, Dealing with Overfitting, Using Network Statistics from the Tuning UI, Detecting Poor Weight Initialization, Detecting Nonshuffled Data, Detecting Issues with Regularization

## Text Books:

1. Deep Learning A Practitioner's Approach by Josh Patterson, Adam Gibson, O'Reilly Publication

## Reference Books:

1. Fundamental of Deep Learning: Designing Next Generation of Machine Learning by Nicholas LoCasio, Nikhil Buduma, O'Reilly Publication

# PCE-CSE-202 Computer Vison

**Lectures:** 3 hr / week **Marks:** 100 Marks

**Tutorial:**1Hr/Week **Term Work:** 25 Marks

## Objectives

1. To learn Digital Image Fundamentals
2. To learn Image Enhancement
3. To learn Image Analysis
4. To learn character recognision

## Outcomes

At the end of the course students will be able to

1. Demonstrate understanding of image fundamentals techniques
2. Demonstrate understanding of Image Enhancement techniques
3. Demonstrate understanding of Image Analysis techniques
4. Demonstrateunderstanding of character recognition techniques

## Course Contents

| | | |
|---|---|---|
| **Unit 1.** | Digital Image Fundamentals: - Digital image Representation – Functional Units of an Image processing system. Visual perception – Image Model _ Image sampling and Quantization – grayscale resolution – pixel relationship – image geometry. Image Transforms – Unitary Transform, Discrete Fourier Transform, Cosine Transform, Sine Transform, Hadamard Transform, Slant and KL Transform. | **7 Hrs.** |
| **Unit 2.** | Image Enhancement – Histogram processing – Spatial operations – Image smoothing- Image Sharpening – Color Image Processing methods-Color Image Models | **6 Hrs.** |
| **Unit 3.** | Image restoration and compression Degradation Model – Discrete Formulation – Circulant matrices – Constrained and Unconstrained restoration geometric transformations fundamentals – Compression Models – Error Free Compression – Lossy Compression – International Image Compression Standards | **7 Hrs.** |
| **Unit 4.** | Image Analysis and Computer Vision: Spatial feature Extraction – Transform feature –Edge detection-Boundary Representation-Region Representation-Moment Representation-Structure-Shape Features-Texture-Scene Matching and Detection-Image Segmentation-Classification techniquesMorphology-Interpolation | **7 Hrs.** |
| **Unit 5.** | Sensing 3D shape: how the 3rd dimension changes the problem. Stereo 3D description, 3Dmodel, matching, TINA. Direct 3D sensing-structured | **6 Hrs.** |

light, range finders, range image segmentation

**Unit 6.** Emerging IT applications: Recognition of characters, Fingerprints and faces-Image databases. **7Hrs**

**Reference Books**

1. Fundamentals of Digital Image Processing-A.K.Jain
2. Image Processing and machine vision-Milan Sonka,VaclavHlavae
3. Pattern Recognition Principles-J.T. Tou and R.C.Gonzalez
4. Syntactic Pattern Recognition and applications.-King Sun Fun
5. Computer vision-Fairhurst (PHI).

# PCE-CSE-202 Pattern Recognition

**Lectures:** 3 hr / week **Marks:** 100 Marks

**Tutorial:**1Hr/Week **Term Work:** 25 Marks

**Course Objectives:**

1. To introduce student to various Pattern recognition techniques.
2. To study the Representation and description and feature extraction.
3. To study the principles of decision trees and clustering in pattern recognition.

**Course Outcomes:**

At the end of the course students will be able to -

1. Develop algorithms for Pattern Recognition.
2. Design the nearest neighbour classifier.
3. Develop and analyse decision tress.

## Course Contents

**Unit 1.** **Introduction:** **7 Hrs**

Definition of PR, Applications, Datasets for PR, Different paradigms for PR, Introduction to probability, events, random variables, Joint distributions and densities, moments. Estimation minimum risk estimators, problems.

**Unit 2.** **Representation:** **7 Hrs**

Data structures for PR, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation.

**Unit 3.** **Nearest Neighbour based classifiers:** **6 Hrs**

Nearest neighbour algorithm, variants of NN algorithms, use ofNN for transaction databases, efficient algorithms, Data reduction, prototype selection.

**Unit 4.** **Bayes classifier:** **6 Hrs**

Bayes theorem, minimum error rate classifier, estimation of probabilities, estimation of probabilities, comparison with NNC, Naive Bayes classifier, Bayesian belief network.

**Unit 5.** **Decision Trees:** **6 Hrs**

Introduction, DT for PR, Construction of DT, Splitting at the nodes, Over-fitting & Pruning, Examples.

**Unit 6.** **Unsupervised Learning & Clustering:** **7 Hrs**

Introduction, Mixture Densities and Identifiability, Maximum-likelihood Estimates, Unsupervised Bayesian Learning, Data Description and Clustering, Criterion Functions for Clustering,Hierarchical Clustering, On-lineclustering, ComponentAnalysis.

**Reference Books**


1. Pattern Recognition (An Introduction) , V Susheela Devi, M Narsimha Murthy, Universities Press.
2. Pattern Recognition & Image Analysis, Earl Gose, Richard Johnsonbaugh, Steve Jost. PHI
3. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, Wiley, 2000.

# PCE-CSE-203 Parallel and Distributed Computing

**Lectures:** 3 hr / week **Marks:** 100 Marks

**Term Work:** 25 Marks

## Course Objectives

1. To justifytheneedofhighperformanceprovidedbyparallelcomputing.
2. To demonstratequantitativedesignprinciplesofparallelcomputingsystems.
3. To identifychallengesfacedwhiledesigningadistributedsystem.
4. To analysethetrends, communication protocols and algorithmsindistributedsystems.

## Course Outcomes

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

1. Justifytheneedofhighperformanceprovidedbyparallelcomputing.
2. Demonstratequantitativedesignprinciplesofparallelcomputingsystems.
3. Identifychallengesfacedwhiledesigningadistributedsystem.
4. Analysethetrends, communication protocols and algorithmsindistributedsystems.

## Course Contents

**Unit 1. Fundamentals of Parallel Computing:** **7 Hrs.**

Instruction-Level Parallelism: Concepts and Challenges, Basic Compiler Techniques for Exposing ILP, Reducing Branch Costs with Prediction, Scheduling, Overcoming Data Hazards with Dynamic Scheduling, Dynamic Scheduling: Algorithm and Examples, Hardware-Based Speculation, Studies of the Limitations of ILP, Limitations on ILP for Realizable Processors, Hardware versus Software Speculation, ILP Support to Exploit Thread-Level Parallelism

**Unit 2. Data-LevelParallelism** **7 Hrs.**

VectorArchitecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units, CPU/GPU ArchitectureComparison,DetectingandEnhancingLoop-LevelParallelism,DataParallelismand SPMDProgrammingModel,NvidiaGPUCaseStudyandProgrammingModel,Example ofARMHeterogeneousArchitecture.

**Unit 3. Thread-LevelParallelism**

IntroductiontoSharedMemoryArchitectures,Looselyand TightlyCoupledMultiprocessors,CentralizedShared-MemoryArchitectures,SnoopyBusCache Coherence, Performance of Shared-Memory Multiprocessors, Distributed Shared Memory and DirectoryCacheCoherence,BasicsofSynchronization,ModelsofMemoryConsistency. **7 Hrs.**

**Unit 4. Introduction to Distributed Computing**

Motivation,Goals,Advantages,Disadvantages,HardwareConcepts, SoftwareConcepts,DesignIssues,Middleware,OverviewofDistributedSystems **4 Hrs.**

**Unit 5. Communication and Synchronization**

ClientServerModel,MiddlewareandClientServerModel,Relationof NetworkModelswithDistributedSystem(TCP/IP,OSI,ATMetc.),RemoteProcedureCall,Group CommunicationanditsProtocol(IS-IS) **8 Hrs.**

**Synchronization:** ClockSynchronization,LogicalClocks,Lamport'sAlgorithm,GlobalState, VectorAlgorithm,ElectionAlgorithms,MutualExclusionAlgorithms,DeadlocksinDistributed Systems,DeadlockAvoidance,PreventionandDetection

**Unit 6. Distributed Modeling**

Threads,SystemModels,ProcessorAllocation,WorkstationModel,ProcessorPool Model,HybridModel,RealTimeDistributedSystems,TimeTriggeredSystems,EventDriven Systems,DistributedSharedMemory,ConsistencyModels,PageBasedDistributedShared Memory,DistributedFileSystem,Design,Implementation,Trends. Applications. **8 Hrs**

**Reference Books**


1. “ParallelComputerArchitecture”,D.E.Culler,J.P.Singh,andA.Gupta,SecondEdition, MorganKaufmann,2017,ISBN:978
2. “Structured Parallel Programming:PatternsforEfficientComputation”,McCool, Michael D., Arch D. Robison and James Reinders, MorganKaufmann,2012,ISBN:978
3. “*DistributedOperatingSystems*",AndrewS.Tanenbaum,PearsonEducation
4. "DistributedOperatingSystemsConceptsandDesign",PradeepK.Sinha, PHIPublication
5. “DistributedOperatingSystems:ConceptsandPractice”,GalliD.L.,Prentice-Hall.

# PCE-CSE-203 Information Retrieval

**Theory:** 3 Hr/Week **Marks:** 100 Marks

**Term Work :** 25Marks

**Course Objectives**

1. To understand need of Information Retrieval
2. To apply Information Retrieval techniques in Information Search
3. To learn Information Retrieval Modeling and Evaluation
4. To understand preprocessing in IR Systems
5. To implement Text based and Web Based Retrieval Systems

**Course Outcomes**

At the end of the course students will be able to demonstrate

1. fundamentals of IR
2. IR modeling
3. IR Evaluation
4. Text based and Web Based Retrieval Systems

**Course Contents**

**Unit 1. Introduction Information Retrieval** **5 Hrs.**

Information Retrieval in Libraries and Digital Libraries, The IR Problem, The IR System, How the Web Changed Search. User Interfaces for Search, Search Interfaces Today, Visualization in Search Interfaces

**Unit 2. Information Retrieval Modeling** **7 Hrs.**

IR Models: Modeling and Ranking, Characterization of an IR Model, A Taxonomy of IR Models, Classic Information Retrieval:Basic Concepts, The Boolean Model, Term Weighting, TF-IDF Weights, Document Length Normalization, The Vector Model, Set-Based Model, Extended Boolean Model, Generalized Vector Space Model , Latent Semantic Indexing Model, The Hypertext Model, Web based Models, Structured Text Retrieval

**Unit 3. Retrieval Evaluation** **6 Hrs.**

Retrieval Metrics: Precision and Recall, Single Value Summaries: P@n, MAP, MRR, F, UserOriented Measures, DCG: Discounted Cumulated Gain, BPREF: Binary Preferences, Rank Correlation Metrics

**Unit 4. Documents: Languages & Properties** **7 Hrs.**

Metadata, Text Document Format, Markup Languages, RDF: Resource Description Framework, Text Properties, Information Theory, Text

Similarity, Document Preprocessing , Lexical Analysis of the Text , Elimination of Stopwords, Stemming , Keyword Selection, Queries: Languages & Properties, Query Languages: Keyword-Based Querying, Structural Queries, Query Protocols, Query Properties

**Unit 5. Text Classification and Indexing** **6 Hrs.**

A Characterization of Text Classification, Unsupervised Algorithms, Supervised Algorithms, Feature Selection or Dimensionality Reduction, Evaluation Metrics, Inverted Indexes

**Unit 6. Web Retrieval** **5 Hrs**

The Web ,Characteristics , Structure of the Web , Modeling the Web , Link Analysis, Search
Engine Architectures, Search Engine Ranking, Managing Web Data, Search Engine User Interaction, Browsing, Beyond Browsing

**Reference Books**

1. Modern Information Retrieval The Concepts and Technology behind Search by Ricardo Baeza-Yates BerthierRibeiro-Neto Second edition Addison-Wesley 2011
2. Introduction to Information Retrieval by C.D. Manning, P. Raghavan, H. Schütze. Cambridge UP, 2008
3. Search Engines: Information Retrieval in Practice by Bruce Croft, Donald Metzler, Trevor StrohmanPearson 2010

# PCE-CSE-203 Natural Language Processing

**Theory:** 3 Hr/Week **Marks:** 100 Marks

**Term Work :** 25Marks

## Course Objectives

1. To explain the fundamentals concepts of natural language processing.
2. To describe word analysis and language modeling for natural language processing.
3. To explain the various applications of natural language processing.

## Course Outcomes

At the end of the course students will be able to

1. Explain the fundamentals concepts of natural language processing.
2. Describe word analysis and language modeling for natural language processing.
3. Explain the various applications of natural language processing.

## Course Contents

**Unit 1. Introduction to NLP** **6 Hrs.**

Introduction, Motivation, Word tokenization, Word normalization, Wordlevel morphology- morphological analysis and synthesis, Stemming - Porters algorithm,Levenshtein distance measure

**Unit 2. Word Tagging** **6 Hrs.**

Sequence labeling tasks of NLP, POS tagging, POS tag sets, Hidden MarkovModel, Viterbi algorithm, Baum Welch Algorithm

**Unit 3. Language Models** **6 Hrs.**

Introduction to N-gram, Probability estimation for n-gram,Evaluation and perplexity, Smoothing techniques, Named-Entity recognition

**Unit 4. Parsing** **10 Hrs.**

Constituency and dependency parsers, Constituency parser –Syntacticstructure, Parsing methodology, Different parsing algorithms, Parsing in case of ambiguity,Probabilistic parsing, CKY algorithm, Issues in parsing, Dependency parsing-Syntactic structure,Parsing methodology, Transition-Based Dependency Parsing, Graph-Based dependency parsing,Evaluation, Co-reference resolution.

**Unit 5. Word Sense Disambiguation** **6 Hrs.**

Word Senses, Word relations, Word similarity and thesaurus methods, Wordsense disambiguation, Knowledge base and supervised WSD, WordNet , Unsupervised basedWSD.

**Unit 6. Applications of NLP** **6Hrs**

Question/Answering system, Text summarization, SentimentAnalysis, Information extraction

## Reference Books


1 Daniel Jurafsky and James H. Martin, “Speech and Language Processing”, SecondEdition, Prentice Hall, 2008, ISBN: 978-0131873216.

2 Allen James, “Natural Language Understanding”, Second Edition, Benjamin/Cumming, 1994, ISBN: 978-0805303346.

3 Chris Manning and HinrichSchuetze, “Foundations of Statistical Natural Language Processing”, MIT Press, ISBN: 978-0262133609.

4 Journals: Computational Linguistics, Natural Language Engineering, Machine Learning, Machine Translation, Artificial Intelligence

5 “Theory of Computer Science”, E. V. Krishamoorthy.

# PW-CSE-201Seminar –I

**Practical: 4**Hr/Week **Term Work:** 25 Marks

Each student is required to do a seminar presentation on a topic preferably from the area in which a student intends to work for his dissertation during Semester – III and Semester – IV. Preparation and presentation of a seminar is intended to investigate an in-depth review of literature, prepare a critical review and develop confidence to present the material by the student. The seminar shall be evaluated by a Department Committee constituted for this purpose, based on a report submitted by the candidate and a viva-voce conducted at the end of the semester.