# PROPOSED SYLLABUS OF COMPUTER SCIENCE AND ENGINEERING

# RTM NAGPUR UNIVERSITY, NAGPUR

# FOR VII AND VIII SEMESTER

# ACADEMIC SESSION: 2015-2016

**FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE**

**SEMESTER: SEVENTH (C.B.S.)**

**BRANCH: COMPUTER SCIENCE & ENGINEERING**

| Sr. No. | Subject | Workload | | | | Credit | | | | Marks | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Theory | | Practical | | Total Marks |
| | | L | P | T | Total | L | P | T | Total | Sess. | Univ. | Sess. | Uni. | |
| 1 BECSE401T | Data Warehousing & Mining | 4 | - | 1 | 5 | 4 | - | 1 | 5 | 20 | 80 | - | - | 100 |
| 2 BECSE401P | Data Warehousing & Mining Lab | - | 2 | - | 2 | - | 1 | - | 1 | - | - | 25 | 25 | 50 |
| 3 BECSE402T | Language Processor | 4 | - | 1 | 5 | 4 | - | 1 | 5 | 20 | 80 | - | - | 100 |
| 4 BECSE402P | Language Processor Lab | - | 2 | - | 2 | - | 1 | - | 1 | - | - | 25 | 25 | 50 |
| 5 BECSE403T | ELECTIVE-I | 4 | - | 1 | 5 | 4 | - | 1 | 5 | 20 | 80 | - | - | 100 |
| 6 BECSE404T | ELECTIVE-II | 4 | - | 1 | 5 | 4 | - | 1 | 5 | 20 | 80 | - | - | 100 |
| 7 BECSE405P | Project and Seminar | - | 3 | - | 3 | - | 3 | - | 3 | - | - | 25 | 25 | 50 |
| | **Total** | **16** | **7** | **4** | **27** | **16** | **5** | **4** | **25** | **80** | **320** | **75** | **75** | **550** |

**Elective I:** TCP and IP, Advanced Computer Architecture, Big Data Analysis & Business Intelligence, Parallel and Network Algorithm.

**Elective II:** Computational Geometry, Mobile Computing, Real Time Operating System, Software Architecture, Mainframe Technologies.

**FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE**

**SEMESTER: EIGHTH (C.B.S.)**

**BRANCH: COMPUTER SCIENCE & ENGINEERING**

| Sr. No. | Subject | Workload | | | | Credit | | | | Marks | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Theory | | Practical | | Total Marks |
| | | L | P | T | Total | L | P | T | Total | Sess. | Univ. | Sess. | Uni. | |
| 1 BECSE406T | Distributed Operating system | 4 | - | 1 | 5 | 4 | - | 1 | 5 | 20 | 80 | - | - | 100 |
| 2 BECSE406P | Distributed Operating system Lab | - | 2 | - | 2 | - | 1 | - | 1 | - | - | 25 | 25 | 50 |
| 3 BECSE407T | Information & Cyber Security | 4 | - | 1 | 5 | 4 | - | 1 | 5 | 20 | 80 | - | - | 100 |
| 4 BECSE407P | Information & Cyber Security Lab | - | 2 | - | 2 | - | 1 | - | 1 | - | - | 25 | 25 | 50 |
| 5 BECSE408T | ELECTIVE-III | 4 | - | 1 | 5 | 4 | - | 1 | 5 | 20 | 80 | - | - | 100 |
| 6 BECSE409T | ELECTIVE-IV | 4 | - | 1 | 5 | 4 | - | 1 | 5 | 20 | 80 | - | - | 100 |
| 7 BECSE410P | Project & Seminar | - | 5 | - | 5 | - | 5 | - | 5 | - | - | 75 | 75 | 150 |
| | **Total** | **16** | **9** | **4** | **29** | **16** | **7** | **4** | **27** | **80** | **320** | **125** | **125** | **650** |

**Elective III:** Pattern Recognition, Soft Computing Techniques, Optimization Techniques, Clustering & Cloud Computing.

**Elective IV:** Advance Wireless Sensor Network, Digital Image Processing, Natural Language Processing, Digital Forensic.

**BECSE401T: Data Warehousing & Mining**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I:** Introduction: Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or a Data Warehouse System, Major issues in Data Mining. Data Preprocessing: Need for Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

**Unit II**: Data Warehouse and OLAP Technology for Data Mining**:** Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Further Development of Data Cube Technology, From Data Warehousing to Data Mining Data Cube Computation and Data Generalization: Efficient Methods for Data Cube Computation, Further Development of Data Cube and OLAP Technology, Attribute-Oriented Induction.

**Unit III:** Mining Frequent Patterns, Associations and Correlations**:** Basic Concepts, Efficient and Scalable Frequent Item set Mining Methods, Mining various kinds of Association Rules, From Association Mining to Correlation Analysis, Constraint-Based Association Mining

**Unit IV:** Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Back propagation, Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods, Prediction, Accuracy and Error measures, Evaluating the accuracy of a Classifier or a Predictor, Ensemble Methods

**Unit V:** Cluster Analysis Introduction: Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Clustering High-Dimensional Data, Constraint-Based Cluster Analysis, Outlier Analysis.

**Unit VI:** Mining Streams, Time Series and Sequence Data: Mining Data Streams, Mining Time-Series Data, Mining Sequence Patterns in Transactional Databases, Mining Sequence Patterns in Biological Data, Graph Mining, Social Network Analysis and Multirelational Data Mining.

**Text Book:**

1. Data Mining – Concepts and Techniques, Jiawei Han & Micheline Kamber, Morgan Kaufmann Publishers, Elsevier, 2nd Edition, 2006.

**Reference Books:**

1. Data Mining Techniques, Arun K Pujari, 3rd edition, Orient Blackswan/Universities Press, 2013.
2. Data Warehousing Fundamentals, Paulraj Ponnaiah, John Wiley & Sons, 2001.

**BECSE401P: Data Warehousing & Mining Lab**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 2 hrs (Practical) | 1 | 50 | 25 | 25 | 50 |

Practical based on the syllabus for the course **BECSE401T.**

**BECSE402T: Language Processor**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I:** Introduction to compilers, compilers and translators, Cross Compiler, Phases of compilation and overview.

Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, scanner generator (lex, flex).

**Unit II:** Syntax Analysis: Syntax specification of programming languages, Design of top-down & bottom-up parsing technique, Design of LL(1) parser. LR parsing: Design of SLR, CLR, LALR parsers. Dealing with ambiguity of the grammar, Parser generator (yacc, bison)

**Unit III:** Syntax directed definitions, implementation of SDTS, Intermediate code representations (postfix, syntax tree, TAC), Intermediate code generation using syntax directed translation schemes for translation of controls structures, declarations, procedure calls, and Array reference.

**Unit IV:** Table Management: Storage allocation and run time storage administration, symbol table management.

Error detection and recovery: Error recovery in LR parsing, Error recovery in LL parsing, automatic error recovery in YACC.

**Unit V:** Code optimization: Sources of optimization, loop optimization, control flow analysis, data flow analysis, setting up data flow equations to compute reaching definitions, available expressions, Live variables, Induction Variable, Common sub expression elimination.

**Unit VI:** Code generation: Problems in code generation, Simple code generator, Register allocation and assignment, Code generation from DAG, Peephole optimization.

**Text Books:**


1. Aho, Sethi, and Ullman; Compilers – Principles, Techniques and Tools; Second Edition, Pearson Education, 2008.
2. Alfred V. Aho and Jeffery D. Ullman; Principles of Compiler Design; Narosa Publishing House, 1977.
3. Vinu V. Das; Compiler Design using Flex and Yacc; PHI Publication, 2008.


**Reference Books:**


1. Compiler Design, O. G. Kakde, Laxmi Publications, 2006.
2. Principles of Compiler Design, V. Raghavan, Tata McGraw Hill, 2009.


**BECSE402P: Language Processor Lab**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 2 hrs (Practical) | 1 | 50 | 25 | 25 | 50 |

Practical based on the syllabus for the course **BECSE402T.**

**BECSE403T: Elective I: TCP & IP**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I:** Network architecture-Standards, TCP/IP Model Overview, Networking Technologies: LANS, WANS, Connecting Devices. Internetworking concept, Internet Backbones, NAP, ISPs, RFCs and Internet Standards.

**Unit II:** Classful Internet address, CIDR-Subnetting and Supernetting, ARP, RARP, OOTP, DHCP.

**Unit III:** IP Datagram-IP Package-IP forwarding and routing algorithms, computing paths, RIPOSPF, ICMP, IGMP.

**Unit IV:** TCP header, services, Connection establishment and termination, Interactive data flow, Bulk data flow, Flow control and Retransmission, TCP timers, Urgent Data processing, Congestion control, Extension headers.

**Unit V:** Switching technology, MPLS fundamentals, signaling protocols, LDP, IP traffic engineering, ECMP, SBR, Routing extensions for traffic engineering, Traffic engineering limitations and future developments.

**Unit VI:** IP security protocol-IPv6 addresses, Packet format, Multicast, Anycast, ICMPv6, Interoperation between IPv4 and IPv6-QoS, Auto configuration.

**Text Books:**


1. TCP/IP Network Administration, Craig Haut, 3rd Edition, Shroff Publications, 2002.
2. Internetworking with TCP/IP - Principles, Protocols, and Architecture, Douglas E. Comer, 5th edition Volume-1, Prentice Hall, 2006.
3. The Internet and its Protocols- A Comparative approach, Adrian Farrel, Morgan Kaufmann, 2004.

4. TCP/IP Illustrated - the Protocols, W. Richard Stevens, Volume I, Pearson Education, 2003.
5. TCP/IP Protocol Suite, Behrouz A. Forouzan, 3rd edition, Tata McGraw Hill, 2006.

**Reference Books:**

1. IPv6 Theory, Protocol and Practice, Pete Loshin, 2nd edition, Morgan Kaufmann, 2003.
2. Internetworking TCP/IP, Comer D.E and Stevens D.L, Volume III, Prentice Hall of India, 1997.

**BECSE403T: Elective I: Advanced Computer Architecture**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (theory)<br>1 hr (tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I:** Fundamentals of Computer Design: Defining computer architecture, trends in technology, trends in power in integrated circuits, trends in cost, dependability, and measuring, reporting and summarizing performance.

**Unit II:** Instruction-Level Parallelism: Concepts and challenges in ILP, basic compiler techniques for Exposing ILP – reducing branch costs with prediction, overcoming data hazards with dynamic scheduling, hardware-based speculation, exploiting ILP using static and dynamic scheduling, limitations of ILP, using ILP support to exploit thread-level parallelism.

**Unit III:** Vector architecture: SIMD instruction set, extensions for multimedia, graphics processing units, detecting and enhancing loop-level parallelism, centralized shared-memory architectures, performance of shared-memory, multiprocessors, distributed shared memory, directory based coherence, basics of synchronization, models of memory consistency.

**Unit IV:** Memory Hierarchy Design: Cache performance: Eleven advanced cache optimizations, Protection via virtual memory and virtual machine, Impact of virtual machines on virtual memory and I/O, memory hierarchies, design of memory hierarchies.

**Unit V:** Introduction to Message passing Architecture: Routing in message passing architecture, message passing programming model, processor support for message passing, message passing versus shared memory architecture.

**Unit VI:** Storage Systems: Advanced topics in disk storage, definition and examples of real faults and failures, i/o performance, reliability measures and benchmarks – designing and evaluating an i/o system.

**Text Books:**


1. Computer Organization and Architecture - Designing for Performance, William Stallings, 8th Edition, Prentice Hall, 2010.
2. Advanced Computer Architecture, Kai Hwang, 2nd Edition, Tata McGraw-Hill, 2011.
3. Advanced Computer Architecture and Parallel Processing, Hesham El-Rewini and Mostafa Abd-El-Barr, Wiley, 2005.


**Reference Books:**


1. Parallel Computing architecture: A hardware / software approach, David E. Culler and Jaswinder Pal Singh, Morgan Kaufmann, 1998.
2. Computer Architecture and Organization, 3rd Edition, J. P. Hayes**,** McGraw Hill, 1999.

**BECSE409T: Elective I: Big Data Analytics and Business Intelligence**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I:** Introduction to Big Data Analytics: Big Data Overview, State of the Practice in Analytics, Data Analytics Lifecycle, data analytics problems. Understanding features of R language, Understanding different Hadoop modes, Understanding Hadoop features, The HDFS and MapReduce architecture.

**Unit II:** Understanding the basics of MapReduce, The Hadoop MapReduce, The Hadoop MapReduce fundamentals, writing a Hadoop MapReduce example, learning the different ways to write MapReduce in R. Integrating R and Hadoop – the RHIPE architecture and RHadoop.

**Unit III:** Learning Data Analytics with R and Hadoop – The data analytics project cycle, the data analytics problems (web page categorization, stock market change), supervised and unsupervised machine-learning algorithms.

**Unit IV:** Introduction to Business Intelligence : evolution of BI, BI value chain, introduction to business analytics, BI Definitions & Concepts, Business Applications of BI, BI Framework, Role of Data Warehousing in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities

**Unit V:** Basics of Data Integration: Concepts of data integration need and advantages of using data integration, introduction to common data integration approaches, data integration technologies, Introduction to data quality, data profiling concepts and applications, the multidimensional data model, star and snowflake schema.

**Unit VI:** BI Project Lifecycle: Typical BI Project Lifecycle, Requirements Gathering and Analysis - Functional and Non-Functional Requirements, Testing in a BI Project, BI Project Deployment , Post Production Support.

**Text Books:**


1. Big Data Analytics with R and Hadoop, Vignesh Prajapati, PACKT Publishing, 2013.
2. Fundamentals of Business Analytics, R N Prasad and S Acharya, Wiley India, 2011
3. Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph; David Loshin, Morgan Kaufmann, 2013.


**Reference Books:**


1. Business Intelligence - A Managerial Approach, 2nd Edition, Efraim Turban, Ramesh Sharda, Dursun Delen and David King, Prentice Hall, 2010.
2. Business Intelligence for Dummies, Swain Scheps, Wiley Publishing, 2007.

**BECSE403T: Elective I: Parallel and Network Algorithm**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I:** Introduction: Parallel computation models, Parallel architectures and topologies, Notion of space and time complexity in parallel and interconnect network environment.

**Unit II:** Dependence Concept: Single Loop, Double Loop and Perfect Loop Nest. Loop carried and Loop independence dependence, Preliminary loop transformation techniques.

**Unit III**: Parallel Algorithms and Techniques 1: Parallel Searching and Sorting Techniques. Hyper quick sort.

**Unit IV**: Parallel Algorithms and Techniques 2: Parallel solutions to linear system of equations, finding roots of non-linear equations, Parallel discrete Fourier transforms.

**Unit V**: Graph and Network Theory 1: Introduction, Shortest Paths, Spanning Trees, Connected Components.

**Unit VI:** Graph and Network Theory 2: Parallel Breadth First Search and Depth First Search, Greedy Algorithms and matroids, Coloring and Matching, Network Flow.

**Text Books:**


1. Graphs, Networks, and Algorithms, Dieter Jungnickel, Third Edition, Springer, 2010.
2. The Design and Analysis of Parallel Algorithms, S.G.Akl, PHI, 1989.
3. Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, Second edition, Addison Wesley, 2003.

**Reference Books:**


1. An Introduction to Parallel Algorithms, J. JaJa, Addison Wesley, 1992.
2. Parallel Programming in C with MPI and OpenMP, M.J.Quinn, McGraw Hill, 2003.

**BECSE404T: Elective II: Computational Geometry**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 4 | 100 | 20 | 80 | 100 |

**Unit I:** Introduction to Computational Geometry; Line Segment Intersection – The Doubly-Connected Edge List, Computing Overlay of Two Subdivisions, Boolean Operations; Polygon Triangulation – Guarding and triangulations, Partitioning a polygon into monotone pieces, triangulating a monotone polygon.

**Unit II:** Linear Programming – The geometry of casting, Half-plane intersection, Incremental and Randomized linear programming; Orthogonal range Searching – One Dimensional range searching, kd-trees, Range trees, higher dimensional range trees.

**Unit III:** Point location – Point location and trapezoidal maps, a Randomized incremental algorithm, dealing with degenerate cases; Voronoi Diagrams – Definition and basic properties, computing the Voronoi diagram; Arrangemnets and Duality – Computing the discrepancy, duality, arrangements of lines, levels and discrepancy.

**Unit IV:** Delaunay Triangulations – Triangulations of planar point sets, the Delaunay triangulation, computing the Delaunay triangulation, the analysis; Geometric Data Structures – Interval trees, priority search trees, segment trees.

**Unit V:** Convex Hulls – The complexity of convex hulls in 3-space, computing convex hulls in 3-space, the analysis, convex hulls and half-space intersection; Binary Space Partitions – the definition of BSP trees, BSP trees and the Painter's algorithm, constructing a BSP tree, the size of BSP tree in 3-space.

**Unit VI:** Quadtrees – Uniform and non-uniform meshes, quadtrees for point sets, from quadtree to meshes; Simplex Range Searching – Partition trees, multi-level partition trees, cutting trees.

**Text Books:**


1. Computational Geometry – Algorithms and Applications, Second Revised Edition, Mark de Berg, et al., Springer, 1998.
2. Discrete and Computational Geometry, Satyan L. Devadoss and Joseph O'Rourke, Princeton University Press, 2011.


**Reference Books:**


1. Computational Geometry – an Introduction, Franco Preparata and Michael Shamos, Springer-Verlag, 1985.

**BECSE404T: Elective II: Mobile Computing**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 4 | 100 | 20 | 80 | 100 |

**Unit I:** History of Wireless Communication, Applications of Wireless Communication, A simplified Reference Model, A second generation 2G services systems, radio link, channel types, antennas and its types. Advantages of Wireless Network over Wired Network.

**Unit II:** Introduction to Cellular system,(Wireless) Medium Access Control: Motivation for a specialized MAC Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA, Comparison of SDMA/FDMA/TDMA/CDMA.

**Unit III:** Introduction to GSM system, GSM background, GSM operational and technical requirements. cell layout and frequency planning, mobile station, base station systems, switching sub systems, home locations register(HLR), Visiting Location Register (VLR), equipment identity register, echo canceller. GSM network structure, Protocols, Localization and calling, Handovers,

**Unit IV:** Mobile Network Layer: Mobile IP, Dynamic Host Configuration Protocol (DHCP). TCP over Wireless Networks – Traditional TCP, Indirect TCP, Snooping TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP.

**Unit V:** Mobile Ad hoc Networks (MANETs): Overview, Properties of a MANET, spectrum of MANET applications, routing and various routing algorithms, multicast routing, security in MANETs.

**Unit VI:** Protocols and Tools: Wireless Application Protocol-WAP; Introduction, protocol architecture, and treatment of protocols of all layers; Bluetooth – User scenarios, physical layer, MAC layer, networking, security, link management; Wireless LAN and J2ME.

**Text Books:**


1. Mobile Computing for beginners, Raksha Shende, Arizona Business Alliance, 2012.
2. Mobile Communications, Jochen Schiller, Second edition, Addison-Wesley, 2004.
3. Handbook of Wireless Networks and Mobile Computing, Stojmenovic and Cacute, Wiley, 2002.


**Reference Books:**


1. Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML, Reza Behravanfar, Cambridge University Press, 2004.
2. Fundamentals of Mobile and Pervasive Computing, Adelstein, Frank, Gupta and Sandeep KS, McGraw-Hill, 2005.
3. Principles of Mobile Computing, Hansmann, Merk and Nicklous, Stober, Springer, Second Edition, 2003.
4. Mobile and Wireless Design Essentials, Martyn Mallick, Wiley DreamTech, 2003.

**BECSE404T: Elective II: Real Time Operating System**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I:** Introduction to Real Time Systems: Real time systems, soft vs. hard real time systems, Concept of computer control, sequence, loop and supervisor control, centralized, hierarchical and distributed systems, applications of real time systems, hardware requirement for real time applications, specialized processors, interfaces, communications.

**Unit II:** Real Time Scheduling: Clock Driven approach, Weighted Round robin approach, Priority Driven approach, Concept of effective release time and deadline, Optimality and non optimality of EDF & LST.

Real Time operating System: Task management, Real Time Clock Handler, Code sharing, Resource Control, Inter task Communication and control.

**Unit III:** Design of Real Time System: Specification, Preliminary Design, multitasking Approach, monitors, Rendezvous.

Design Analysis: Introduction, Petri nets, Analysis of Petri Nets, Scheduling problem, Real Time Database, Real Time Vs General Purpose Databases, Transaction priorities and Aborts, Concurrency Control, Disk Scheduling Algorithms, Maintaining Serialization Consistency.

**Unit IV:** Programming Language and Tools: Desired language characteristics, Data typing, Control structures, Facilitating hierarchical decomposition , packages, Run time error handling, Overloading and generics, Multitasking, Low level programming, Task scheduling, Timing specifications, Programming environments, Run time support.

**Unit V:** Fault Tolerance Techniques: Introduction, Faults, Errors and Failures, Fault types, Detection and Containment, Redundancy, Integrated Failure Handling.

**Unit VI:** Reliability Evolutions: Introduction, Parameters, Reliability Models for Hardware, Software Error Models.

Commercial Real Time Systems: General concepts, Unix and Windows as RTOS.

**Text Book:-**

1. Real-Time Systems, Jane W. Liu, Pearson Education, 2001.

**Reference Books:**

1. Real-Time Systems: Theory and Practice, Rajib Mall, Pearson, 2008.

2. Real-Time Systems, Jane W. Liu, Pearson Education, 2001.

3. Real-Time Systems, Krishna and Shin, Tata McGraw Hill. 1999.

**BECSE404T: Elective II: Software Architecture**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I:** Introduction: Software process and the role of modeling and analysis, software architecture and software design, architectural styles, architectural patterns, analysis of architectures, formal descriptions of software architectures, architectural description languages and tools, scalability and interoperability issues, web application architectures, case studies.

**Unit II:** Quality Attributes: Introduction to Quality Attributes, Need of quality attributes, Understanding quality attributes, architecture and quality attributes, achieving quality attributes. Quality attributes in software architecture templates. Deriving duality attributes for software architectures.

**Unit III:** Design patterns: Pattern Systems, Patterns and Software architecture. Software architecture and maintenance management; Design Patterns: history, principles and expectations. Study of representative patterns like Singleton, Factory, Adaptor, Facade, Proxy, Iterator, Observer, Mediator, Composite, chain of ways of using patterns.

**Unit IV:** Architectural styles: Conventional Architectural styles, Applied Architectures and Styles: Distributed and Networked, Architectures for Network-Based Applications Architectures, Decentralized Architectures, Service-Oriented Architectures and Web Services.

**Unit V:** Introduction to Middleware: Middleware components, programming models, implementation, systems qualities Moving from qualities to architecture and views ,Components and COTS, Economics- Driven Architecture, Software product line, Software architecture future.

**Unit VI:** Web Architecture: Introduction to Web Architectures, Client side technologies, Need of Client side technology in multi-tier architectures, Need of server side technology in multi-tier architectures, Server side technologies.

**Text Book:**


1. Software Architecture: Foundations, Theory, and Practice, Richard N. Taylor, Nenad Medvidovic and Eric Dashofy, Wiley, 2008.
2. Software Architecture - Perspectives on an Emerging Discipline, M. Shaw, Prentice Hall, 1996.
3. Software Architecture in Practice, Len Bass, Paul Clements and Rick Kazman, Pearson Education, 3rd Edition, 2012.


**Reference Books:**


1. Beginning J2EE 1.4: From Novice to Professional, James L. Weaver, Kevin Mukhar, Apress, 2004.
2. Design and Use of Software Architectures, Jan Bosch, Addison-Wesley, 2000.
3. Software Architecture: Organizational Principles and Pattern, Dikel D. M, et Al, Pearson, 2001.

**BECSE404T: Mainframe Technologies**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I:** Evolution of Mainframe computer, key features , benefits ,Basic IBM Mainframe Architecture, Input/output Devices, Virtual/Real/Auxiliary Storage Concepts, MVS Storage & Control Blocks , Mainframe Operating System.

**Unit II**: Z/OS Operating System, concepts of Address space, Buffer management, Dataset organization, Virtual Storage Access Method, VSAM overview, VSAM Advantage and Disadvantage, CLUSTER, Data organization of VSAM, Internal Organization of VSAM, Accessing VSAM Data Set, Introduction to CICS , Execution of CICS Application.

**Unit III:** Job Control language, Basic concept of JCL, Job Processing, JCL Statements and procedures, Data Definition Statements, JOB Statement, EXEC Parameter Coding Data Sets and I/O on DD statement, In-Stream and Catalog Procedures , Generation Data Group (GDG) ,IBM utility programs. SORT/MERGE Utilities.

**Unit IV**: COBOL Programming Introduction, Evolution & features, COBOL divisions & sections COBOL statements, Redefines Rename & Usage clause, COBOL program structure, data types, COBOL verbs, conditional & sequence control verbs.

**Unit V:** COBOL File processing, File concepts, Physical & logical records, File Organization, File handling verbs, Sorting & merging of files, Table handling, Character handling, , COBOL subroutines.

**Unit VI:** Introduction to DB2 , DB2 Objects & Data Types, Structured Query Language, DB2 Interfaces, DB2 application development overview, Embedded SQL Programming, Cursor programming, SQL execution validation, Locking and Concurrency.

**Text Book:**


1. Introduction to the New Mainframe: z/OS Basics, Mike Ebbers, John Kettner, Wayne O' Brien and Bill Ogden, IBM Redbooks, 2011.
2. Information Systems through COBOL, Andreas Philippakis and Leonard Kazmier, McGraw-Hill, 1978.
3. DB2: The Complete Reference, Paul C. Zikopoulos and Roman B. Melnyk, Tata McGraw Hill, 2002.


**Reference Books:**


1. A Complete Guide to DB2 Universal Database, Don Chamberlin, Morgan Kauffman, 1998.
2. Structured COBOL Programming, 8th Edition, Stern, Wiley and Sons, 2007.

## VIII SEMESTER CSE

### BECSE406T: Distributed Operating System

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I:** Fundamentals: Introduction, Models and Features, Concept of Distributed Operating system, Issues in Design of a Distributed Operating System.

Foundations of Distributed System: Limitations of Distributed Systems, Lamport's logical clocks, Vector clocks, Causal ordering of messages, Global state recording, Cuts of a Distributed Computation, Termination Detection.

**Unit II:** Distributed Mutual Exclusion: Requirement of Mutual Exclusion Algorithm, Non Token Based Algorithms: Lamport's Algorithm, Ricard-Agrawala Algorithm, Maekawa's Algorithm, Token Based Algorithms: Suzuki-Kasami's Broadcast Algorithm, Singhal's Heuristic Algorithm, Raymond's Tree-Based Algorithm, Comparative Performance Analysis.

**Unit III:** Distributed Deadlock Detection: Introduction, Deadlock Handling strategies in Distributed System, Centralized and Distributed Deadlock Detection Algorithms.

Agreement protocols: Introduction, System Model, Classification of Agreement Problems, Solutions to the Byzantine Agreement Problem.

**Unit IV:** Distributed File system: Introduction to Distributed File System, Architecture, and Mechanism for Building Distributed File System.

Distributed Shared Memory: General Architecture of DSM systems, Algorithm for Implementing DSM, Memory coherence and Coherence Protocols.

**Unit V:** Distributed Scheduling: Introduction, Issues in Load Distributing, Components of a Load Distributing Algorithm, Load Distributing Algorithms: Sender-Initiated Algorithm, Receiver-Intiated algorithm, Symmetrically Initiated

Algorithm, Adaptive Algorithm, Requirements for Load Distributing Task Migration, Issues in Task Migration.

**Unit VI:** Failure Recovery: Recovery in concurrent systems, Consistent set of Checkpoints, Synchronous check pointing and Recovery, Asynchronous check pointing and Recovery.

Fault Tolerance: Introduction, Commit Protocols, Static Voting Protocol, Dynamic Voting Protocol.

**Text Books:**

1. Advanced Concepts in Operating Systems, Mukesh Singhal and Niranjan Shivaratri, Tata McGraw Hill, 2001.
2. Distributed Systems - Concepts and Design, Coulouris, Dollimore and Kindberg, 5th Edition, Addison-Wesley, 2012.

**Reference Books**:

1. Distributed Operating System, Andrew S. Tanenbaum, Pearson Education, 2003.

**BECSE406P: Distributed Operating System Lab**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 2 hrs (Practical) | 1 | 50 | 25 | 25 | 50 |

Practical based on the syllabus for the course **BECSE406T.**

**BECSE407T: Information & Cyber Security**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I:** Need of Information Security: Legal, Ethical and Professional Issues Attributes of security- authentication, access control, confidentiality, authorization, integrity, non-reproduction.

OSI Security Architecture: attacks, services and mechanisms. Security Attacks, Security services, A model of Internetwork Security.

Conventional Encryption: Classical Encryption Techniques and Problems on classical ciphers, Security architecture.

**Unit II:** Introduction to Secret key and cryptography, Encrypt given messages using DES, AES, IDEA, Problems on cryptography algorithms, Principles, finite fields, stream cipher, block cipher modes of operation, DES, Triple DES, AES, IDEA, RC5, key distribution.

**Unit III:** Introduction to Public key and Cryptography, Encrypt given messages using ECC, Problems on key generation, cryptography algorithms Principles, Introduction to number theory, RSA- algorithm, security of RSA, Key management- Diffie-Hellman key exchange, man-in-the-middle attack, Elliptical curve cryptography

**Unit IV:** Message Authentication and Hash Functions: Authentication Requirements and Functions, Hash Functions and their Security, MD5 Message Digest Algorithm, Kerberos.

Key Management: Digital Certificates-Certificate types, X.509 Digital Certificate format, Digital Certificate in action, Public Key Infrastructure-Functions, PKI Architecture, Certificate Authentication.

**Unit V:** Introduction to Network, Transport and Periphery Security, Study of IPSEC, TLS, and SSL. Firewalls - design principles, trusted systems, Intrusion Detection System, Intrusion Prevention System. Implementation and analysis of IPSEC, TLS and SSL, Introduction to cryptography - Classical cryptography.

**Unit VI:** Software Vulnerability: Phishing, Buffer Overflow, Cross-site Scripting (XSS), SQL Injection.

Electronic Payment: Payment Types, Enabling Technologies-Smart Cards and Smart Phones, Cardholder Present E-Transaction-Attacks, Chip Card Transactions, Payment over Internet-Issues and Concerns, Secure Electronic Transaction, Online Rail Ticket Booking.

Electronic Mail Security: Pretty Good Privacy, S/MIME

**Text Book:**

1. Cryptography and network security - principles and practices, William Stallings, Pearson Education, 2002.

**Reference Books:**

1. Network Security and Cryptography, Bernard Menezes, Cengage Learning.
2. Information System Security, Nina Godbole, Wiley India, 2008.
3. Network security, private communication in a public world, Charlie Kaufman, Radia Perlman and Mike Speciner, Prentice Hall, 2002.
4. Security architecture, design deployment and operations, Christopher M. King and Curtis Patton, RSA press, 2001.
5. Network Security - The Complete Reference, Robert Bragg and Mark Rhodes, Tata McGraw Hill, 2004.

**BECSE407P: Information & Cyber Security Lab**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 2 hrs (Practical) | 1 | 50 | 25 | 25 | 50 |

Practical based on the syllabus for the course **BECSE407T.**

**BECSE408T: Elective-III: Pattern Recognition**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I**: Introduction: Pattern Recognition Systems, Design Cycle, Applications of pattern recognition, Learning and Adaption-Supervised, Unsupervised and Reinforcement Learning.

**Unit II:** Probability: Introduction to Probability, Probability of events, Random variables, Probability Distributions, Joint Distribution and Densities, Moments of Random Variables, Estimation of Parameters from samples, Minimum Risk Estimators.

**Unit III:** Statistical Decision Making: Bayes' Decision Theory, Multiple Features, Conditionally Independent Features, Decision Boundaries, Unequal costs of Error, Estimation of Error Rates, Leaving-one-out Technique, Confusion Matrix, Characteristic Curves.

**Unit IV:** Classifiers: Hidden Markov Model, Support Vector Machine, Artificial Neural network-back Propagation Algorithm and Fuzzy based classifiers.

**Unit V:** Non Parametric Decision Making: Introduction**,** Histograms, Kernel and window Estimators, Nearest Neighbor classification Technique, Adaptive Decision Boundaries, Adaptive Discriminate Functions, Minimum Squared Error Discriminate Functions.

**Unit VI:** Clustering: Introduction, Hierarchical clustering, Partitional Clustering.

**Text Book:**

1. Pattern Recognition and Image Analysis, Earl Gose, Richard Johnsonbaugh and Steve Jost, PHI, 1996.

**Reference Book:**

1. Pattern Classification, Richard O Duda, Peter E. Hart and David G. Stork, John Wiley, 2000.

**BECSE408T: Elective III: Soft Computing Techniques**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I**: Introduction to Neuro: Fuzzy and Soft Computing**:** Soft Computing Constituents and Conventional AI; Neuro-Fuzzy and Soft Computing Characteristics.

Fuzzy Sets: Introduction Set Theoretic Operations, MF Formulation and Parameterization, Fuzzy Union, Intersection and Complement.

Fuzzy Rules and Fuzzy Reasoning: Extension Principles and Fuzzy Relations, Fuzzy If-Then Rules; Fuzzy Reasoning.

**Unit II:** Fuzzy Inference Systems: Mamdani Fuzzy Models; Sugeno Fuzzy Models, Tsukamoto Fuzzy Models, Other Considerations.

Derivative-Free Optimization: Introduction, Genetic Algorithms; Simulated Annealing; Random Search, Downhill Simplex Search.

**Unit III**: Adaptive Networks: Introduction, Architecture; Feed-forward Network; Extended Back-propagation for Recurrent Networks; Hybrid Learning Rule. Supervised Learning Neural Networks, Perceptrons, Back-propagation Multi-layer Perceptrons, Radial Basis Function Networks.

**Unit IV:** Unsupervised Learning and Other Neural Networks: Competitive Learning Networks, Kohonen Self-Organizing Networks; Learning Vector Quantization; Hebbian Learning, Principal Component Networks, Hopfield Networks.

**Unit V**: Adaptive Neuro-Fuzzy Inference System**:** ANFIS Architecture, Hybrid Learning Algorithm, ANFIS as Universal Approximator.

Data Clustering Algorithms: K-Means Clustering; Fuzzy C-Means Clustering, Mountain Clustering Method; Subtractive Clustering.

**Unit VI:** Rulebase Structure Identification: Input Selection, Input Space partitioning, Rulebase Organization, Focus Set-based Rule Combination.

Applications: Printer Character Recognition, Hand-written Numeral Recognition, GA-based Fuzzy Filters.

**Text Books:**


1. Neuro-Fuzzy and Soft Computing – A Computational Approach to Learning and Machine Intelligence; Jyh-Shing Roger Jang, Chuen-Tsai Sun and Eiji Mizutani; Prentice Hall, 2004.
2. Artifical Intelligence and Soft Computing, Anindita Das, Shroff Publication.


**Reference Books:**


1. Fuzzy Logic with Engineering Applications; Timothy J. Ross; McGraw-Hill; 1997.
2. Genetic Algorithms: Search, Optimization and Machine Learning; Davis E. Goldberg; Addison Wesley; 1989.
3. Neural Networks, Fuzzy Logic and Genetic Algorithms; S. Rajasekaran and G. A. V. Pai; Prentice Hall of India; 2003.

**BECSE408T: Elective III: Optimization Techniques**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I:** Introduction: Engineering applications of optimization. Design variables. Constraints, objectives function, variable bounds, statement and formulation of an optimization problem, Example of Optimization problems, classification of optimization problems, different optimization algorithms.

**Unit II**: Optimal Point: Local optimal point, global optimal point and inflection point.

**Unit III:** Single Variable Optimization Techniques: Optimality criterion, Bracketing method (Bounding phase method), Region elimination methods (Internal halving method, Golden section search method), Point estimation method (successive quadratic estimation methods), Gradient-based methods (Newton-Raphson method, Bisection method, secant, Cubic search method.), Root finding using optimization techniques.

**Unit IV:** Multivariable Optimization Techniques: Optimality criterion, Unidirectional search method, Direct Search method (Hooke-Jeeves Pattern Search method, Powell's conjugate direction method), Gradient-based methods (Steepest descent method, Newton's method, and Marquardt's methods)

**Unit V:** Constrained Optimization Algorithms**:** Kuhn-Tucker conditions, Transformation method (Penalty function method), direct search for constrained minimization (variable elimination method, complex search method)

**Unit VI:** Linear Programming: Linear programming problems, Simplex method of linear programming techniques.

**Text Book:**

1. Optimization for Engineering Design: Algorithms and Examples, Kalyanmoy Deb, PHI Learning, 2004.

**Reference Books:**


1. Engineering Optimization: Theory and Practice, Singiresu S. Rao, John Wiley 2009.
2. Optimization of Chemical Processes, T.I. Edgar & D.M. Himmelblau, McGraw Hill.
3. Optimization: Theory and Practice, Beveridge and Schecter, McGraw Hill.

**BECSE408T: Elective III: Clustering & Cloud Computing**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I:** Introduction to Cloud Computing: Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Properties, Characteristics & Disadvantages of Cloud Computing, Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing. Legal issues when using cloud models, challenges in cloud computing, Overview of Mobile Cloud.

**Unit II:** Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services, Service Models (XaaS), Infrastructure as a Service (IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), Virtualization Technology: Virtual machine technology, virtualization applications in enterprises, Pitfalls of virtualization, Infrastructure as a Service (Iaas)using OpenStack/OwnCloud.

**Unit III:** Big Data Analysis, Hadoop and Map Reduce: Introduction, Clustering Big Data, Classification of Big Data, Hadoop MapReduce Job Execution, Hadoop scheduling, Hadoop cluster setup, configuration of Hadoop, starting and stopping Hadoop cluster.

**Unit IV:** Security in Cloud: Cloud Security Challenges, Infrastructure Security, Network level security, Host level security, Application level security, data privacy, data security, application security, virtual machine security, Identity Access Management, Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations.

**Unit V:** Application Development using C#: Understand object oriented concepts in C#.NET, Creation of UI and event handling, web page creation using ASP.NET, ADO.NET architecture, implementation of data seta, using ADO.NET in console application, using ADO.NET in web application.

**Unit VI:** Creating Cloud Application using Azure: Creating simple cloud application, configuring an application, creating virtual machine, deployment of application to Windows Azure Cloud, using Azure Storage Services, using Azure Table Service, deployment of application to the production environment.

**Text Books:**


1. Google Compute Engine, Mark Cohen and K. Hurley, O'Reilly, 2014.
2. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley, 2011
3. Cloud Computing, A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2014.
4. Microsoft Azure: Enterprise Application Development, R. J. Dudley and N. A. Duchene, SPD Publication.


**Reference Books:**


1. Cloud Computing using Windows Azure, B. M. Harwani, SPD Publication.
2. Cloud Computing, Implementation, Management and Security, J. W. Rittinghouse and J. F. Ransome, CRC Press.

**BECSE409T: Elective IV: Advanced Wireless Sensor Networks**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I: Introduction to Sensor networks**: application Examples of available sensor nodes, Challenges for WSN's, Mobile ad hoc networks and wireless sensor networks, single node architecture. Sensor node hardware overview, Sensors and actuators, Energy consumption of sensor nodes

**Unit II: Operating systems and execution environments**: Programming paradigms and application programming interfaces, Structures of operating system and protocol stack. Dynamic energy and power management, TinyOS and neSc examples

**Unit III: Network Architecture**: Sensor network scenarios, Design principles for WSNs, Services interfaces of WSNs, Gateway concepts, Mac protocols: Fundamentals, Low duty cycle and Wakeup concepts, contention and schedule based protocols, IEEE 802.15.4 MAC Protocol.

**Unit IV: Naming and Addressing:** Fundamentals Address and Name management in WSN, assignment in MAC Addresses, content based and geographical addressing. Hierarchical networks by clustering, Adaptive node activity: geographic adaptive Fidelity (GAF).

**Unit V: Routing protocols and content based** networking: Broadcast and multicast protocols Geographic Routing, Mobile nodes, Data centric Routing, Distribution versus gathering of data-In-network processing, Data Aggregation, data centric storage.

**Unit VI**: **Application specific support:** Advanced in-network processing, security, Target detection and tracking, contour/edge detection.

**Text Books:**


1. Protocols and Architectures for Wireless Sensor Networks, Holger Karl, and Andreas Willig, Wiley, 2005.
2. Wireless Sensor Networks, Cauligi S. Raghavendra, Krishna Sivalingam and Taieb M. Znati, Springer, 2005.
3. Introduction to Wireless and Mobile Systems, Third edition, Dharma Prakash Agrawal and Qing-An Zeng, Thomson/Cengage Learning, 2010.


**Reference Books:**


1. Wireless and Personal Communications Systems, Vijay K. Grag and Joseph E. Wilkes, Prentice Hall, 1995.
2. Routing in the Internet, Christian Huitema, Prentice Hall, 1995.

**BECSE409T: Elective IV: Digital Image Processing**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I:** Introduction: What is Digital Image Processing, Applications of Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of Image Processing System.

Digital Image Fundamentals: Elements of Visual Perception, Image Sampling and Quantization, Basic Relationships between Pixels.

Intensity Transformations: Basic Intensity Transformation Functions, Piecewise-Linear Transformations.

**Unit II:** Spatial Filtering: Histogram Processing – Histogram Equalization, Histogram Specification, Using Histogram Statistics for Image Enhancement, Fundamental of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.

Color Image Processing: Color Fundamentals, Color Models – RGB Model, CMY and CMYK Model, HSI Model, Pseudo-color Image Processing – Intensity Slicing, Intensity-to-Color Transformations.

**Unit III:** Filtering in Frequency Domain: Preliminary Concepts, Discrete Fourier Transform of One Variable, Extensions to Functions of Two Variables, Properties of 2-D DFT, Basics of Filtering in Frequency Domain, Image Smoothing using Frequency Domain Filters, Image Sharpening using Frequency Domain Filters; Selective Filtering.

**Unit IV:** Image Restoration and Reconstruction: Model of Image Degradation/Restoration Process, Noise Model, Restoration in the Presence of Noise only – Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position Invariant Degradations, Inverse Filtering, Wiener Filtering; Constrained Least Squares Filtering, Geometric Mean Filter.

**Unit V:** Image Compression: Fundamentals – Coding Redundancy, Spatial-Temporal Redundancy, Measuring Image Information, Fidelity Criteria, Image

Compression Models, Basic Compression Methods – Huffman Coding, Arithmetic Coding, Run-length Coding, LZW Coding; Digital Image Watermarking.

**Unit VI**: Image Segmentation: Point, Line and Edge Detection – Detection of Isolated Points, Line Detection, Edge Models, Basic Edge Detection, The Marr-Hildreth Edge Detector, The Canny Edge Detector, Edge Linking and Boundary Detection; Thresholding – Basic Global Thresholding, Otsu's Method; Region-Based Segmentation – Region Growing, Region Splitting and Merging.

Representation and Description: Boundary Following; Chain Codes; Polygonal Approximations using MPP; Signatures; Skeletons; Shape Numbers; Topological Descriptors.

**Text Books:**


1. Digital Image Processing; Rafael C. Gonzalez and Richard E. Woods; Third Edition; Pearson Education (India); 2014.
2. Digital Image Processing and Analysis; B. Chanda and D. Dutta Majumdar; Prentice Hall of India, 2001.
3. Digital Image Processing; S. Jayaraman, S. Essakkirajan and T. Veerakumar; Tata McGraw Hill; 2009.


**Reference Books:**


1. Digital Image Processing and Computer Vision; Milan Sonka, Vaclav Hlavac and Roger Boyle; Cengage Learning; 2008.
2. Digital Image Processing; Kenneth R. Castleman; Pearson Education (India); 1996.
3. Fundamentals of Digital Image Processing; Anil K. Jain; PHI Learning; 2013.

**BECSE409T: Elective IV: Natural Language Processing**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I:** Introduction: NLP tasks in syntax, semantics, and pragmatics, Key issues &Applications such as information extraction, question answering, and machine translation, the problem of ambiguity, the role of machine learning, brief history of the field.

**Unit II:** N-gram Language Models : Role of language models, Simple N-gram models, Estimating parameters and smoothing, Evaluating language models, Part Of Speech Tagging and Sequence Labeling Lexical syntax, Hidden Markov Models, Maximum Entropy models.

**Unit III:** Syntactic parsing: Grammar formalisms and tree banks, Efficient parsing for context-free grammars (CFGs), Statistical parsing and probabilistic CFGs (PCFGs), Lexicalized PCFGs.

**Unit IV:** Semantic Analysis: Lexical semantics and word-sense disambiguation, Compositional semantics, Semantic Role labeling and Semantic Parsing.

**Unit V:** Information Extraction (IE): Named entity recognition and relation extraction, IE using sequence labeling, automatic summarization Subjectivity and sentiment analysis.

**Unit VI:** Machine Translation (MT): Basic issues in MT, Statistical translation, word alignment, phrase-based translation, and synchronous grammars.

**Text Books:**


1. Speech and Language Processing, D. Jurafsky and R. Martin, 2nd edition, Pearson Education, 2009.
2. Language Implementation Patterns, Terence Parr, Pragmatic Programmers, 2010.

**Reference Books:**


1. Natural Language Understanding, Allen James, Second Edition, Benjamin/Cumming, 1995.
2. NLP: A Paninian Perspective, Akshar Bharati, Vineet Chaitanya, and Rajeev Sangal, Prentice Hall, New Delhi, 1994.

**BECSE409T: Elective IV: Digital Forensics**

| Load | Credit | Total marks | Sessional marks | University marks | Total |
|---|---|---|---|---|---|
| 4 hrs (Theory)<br>1 hr (Tutorial) | 5 | 100 | 20 | 80 | 100 |

**Unit I:** Introduction & evidential potential of digital devices – Key developments, Digital devices in society, Technology and culture, Comment, Closed vs. open systems, evaluating digital evidence potential. Device Handling & Examination Principles: Seizure issues, Device identification, Networked devices, Contamination, Previewing, Imaging, Continuity and hashing, Evidence locations.

**Unit II:** A seven element security model, A developmental model of digital systems, Knowing, Unknowing, Audit and logs, Data content, Data context. Internet & Mobile Devices, The ISO / OSI model, the internet protocol suite, DNS, Internet applications, Mobile phone PDAs, GPS, Other personal technology.

**Unit III:** Introduction to Computer Forensics, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources / Employment Proceedings, Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps Taken by Computer Forensics Specialists, Who Can Use Computer Forensic Evidence?, Case Histories, Case Studies.

**Unit IV:** Types of Military Computer Forensic Technology, Types of Law Enforcement: Computer Forensic Technology, Types of Business Computer Forensic Technology, Specialized Forensics Techniques, Hidden Data and How to Find It, Spyware and Adware, Encryption Methods and Vulnerabilities, Protecting Data from Being Compromised, Internet Tracing Methods.

**Unit V:** Homeland Security Systems, Occurrence of Cyber Crime, Cyber Detectives, Fighting Cyber Crime with Risk Management Techniques, Computer Forensics Investigative Services, Forensic Process Improvement, Case Histories.

**Unit VI:** The violation of privacy during information words. The individual exposed. Advanced computer Forensics systems and future directions-advanced, encryption, hacking, advanced trackers, case studies.

**Text Books:**


1. Digital Forensics, Angus M. Marshall, 2nd Edition, Wiley-Blackwell, John Wiley and Sons, 2008.
2. Computer forensics: Computer Crime Scene Investigation, John R. Vacca, 2nd Edition, Charles River Media, 2002.


**Reference Books:**


1. Recovering and examining computer forensic evidence, Michael G. Noblett; Mark M. Pollitt and Lawrence A. Presley, 2000.
2. A Formalization of Digital Forensics, R Leigland, 2004.
3. Evaluating Commercial Counter-Forensic Tools, M. Geiger, DFRWS-2005.
4. Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Evidence of Computer Crimes, Albert J. Marcella and Robert S. Greenfield, Auerbach Publications, 2007.
5. Handbook of Computer Crime Investigation: Forensic Tools and Technology, Eoghan Casey, Academic Press, 2001.
6. Privacy Protection and Computer Forensics, Second Edition, Michael Caloyannides, Artech House, 2004.
7. Computer Forensics: Incident Response Essentials, Warren G. Kruse and Jay G. Heiser, Addison Wesley, 2001.