Semester VI (Third year)

Subject wise Detail Syllabus

(Sixth semester onwards)

Undergraduate Degree in Engineering & Technology

Branch/Course:

COMPUTER SCIENCE & ENGINEERING

ARYABHATTA KNOWLEDGE UNIVERSITY
Chanakya National Law University Campus
Mithapur, Patna-800001 www.akubihar.ac.in

Semester VI (Third year)

SI. No.	Type of course	Code	Course Title	Hours per week			Credits
				Lecture	Tutorial	Practical	
1	Professional Core Courses	PCC-CS 601	Compiler Design	3	0	4	5
2	Professional Core Courses	PCC-CS 602	Computer Networks	3	0	4	5
3	Professional Core Courses	PCC-CS 603	Machine Learning	3	1	0	4
4	Professional Elective Courses	PEC CS 6XX	Elective-I	3	0	0	3
5	Professional Elective Courses	PEC CS 6XX	Elective-II	3	0	0	3
6	Project and Seminar	PNS CS 601	Project - I	0	0	4	2
7	Professional Elective Laboratory	PEL CS 6XX	Professional Elective Lab-I	0	0	2	1
						Total credits	**23**

Professional Elective – I 6th Sem	Graph Theory	Signals and Systems	Computer Graphics	Probability and Statistical Interface	Introduction to Java Programming			
Professional Elective – II 6thSem	Distributed Database	Cryptography and Network Security	Advanced Computer Architecture	Multimedia Technology and its Applications	Advance Java Programming	Data Science	3D Printing and Design	Web and Internet Technology

PCC CS 601	Complier Design	3L:0T: 4P	5 Credits
Pre-requisites	Formal Language & Automata Theory		

Objectives of the course

- To understand and list the different stages in the process of compilation.
- Identify different methods of lexical analysis
- Design top-down and bottom-up parsers
- Identify synthesized and inherited attributes
- Develop syntax directed translation schemes
- Develop algorithms to generate code for a target machine
- To study the underlying theories in designing of a compiler
- The study especially consider the imperative languages

Detailed contents

Module 1 **Lecture: 6 hrs.**

Introduction: Phases of compilation and overview.

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

Module 2 **Lecture: 9 hrs.**

Syntax Analysis (Parser): Context-free languages and grammars, push-down automata, LL(1) gram-mars and top-down parsing, operator grammars, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison).

Module 3 **Lecture: 10 hrs.**

Semantic Analysis: Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree.

Symbol Table: Its structure, symbol attributes and management. Run-time environment: Procedure activation, parameter passing, value return, memory allocation, and scope.

Module 4 **Lecture: 10 hrs.**

Intermediate Code Generation: Translation of different language features, different types of intermediate forms.

Code Improvement (optimization) Analysis: control-flow, data-flow dependence etc.; Code improvement local optimization, global optimization, loop optimization, peep-hole optimization etc.

Architecture dependent code improvement: instruction scheduling (for pipeline), loop optimization (for cache memory) etc. Register allocation and target code generation.

Module 5 **Lecture: 5 hrs.**

Advanced topics: Type systems, data abstraction, compilation of Object Oriented features and non-imperative programming languages.

Suggested Books:

1. Compilers Principles Techniques And Tools by Alfred V. Aho, Ravi Sethi, Jeffery D. Ullman. Pearson Education.

Suggested Reference Book

1. Compiler Design by Santanu Chattopadhyay. PHI
2. Modern Compiler Design by Dick Grune, E. Bal. Ceriel, J. H. Jacobs, and Koen G. Langendoen, Viley Dreamtech.

Course Outcomes

After the completion of course, students can able to able to:

1. Develop the lexical analyser for a given grammar specification.
2. Design top-down and bottom-up parsers for a given parser specification
3. Develop syntax directed translation schemes
4. Develop algorithms to generate code for a target machine

PCC CS 601P	**Complier Design Lab**

Hands-on experiments related to the course contents of PCC CS 601.

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PCC CS 602	**Computer Networks**	**3L:0T: 4P**	**5 Credits**
Pre-requisites	**PCC CS 402 & PCC CS 403**		

Objectives of the course

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs). To provide an opportunity to do network programming To provide a WLAN measurement ideas.

Detailed contents

Module 1 **Lecture 8 hrs.**

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

Module 2 **Lecture 8 hrs.**

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

Module 3 **Lecture 8 hrs.**

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

Module 4 **Lecture 8 hrs.**

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

Module 5 **Lecture 8 hrs.**

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

Suggested books

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.

Suggested reference books

1. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
3. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison- Wesley, United States of America.

Course Outcomes

After the completion of course, students can able to able to:

1. Explain the functions of the different layer of the OSI Protocol.
2. Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) and can able to describe the function of each block.
3. Program for a given problem related TCP/IP protocol.
4. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

PCC CS 602P	**Computer Networks Lab**

Hands-on experiments related to the course contents of PCC CS 602.

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PCC-CS603	Machine Learning	3L: 1T:0 P	4 Credits

Objectives of the course

- To learn the concept of how to learn patterns and concept from data.
- Design and analyze various machine learning algorithms and their applications in recent trends.
- Evaluate the various factors of machine learning to measure the performance.
- Understand basic of machine learning's application in recent trend of technology. **Detailed contents**

Module 1 **Lecture 8 hrs.**

Introduction: Basic definitions, Linear Algebra, Statistical learning theory, types of learning, hypothesis space and Inductive bias, evaluation and cross validation, Optimization.

Module 2 **Lecture 8 hrs.**

Statistical Decision Theory, Bayesian Learning (ML, MAP, Bayes estimates, Conjugate priors), Linear Regression, Ridge Regression, Lasso, Principal Component Analysis, Partial Least Squares

Module 3 **Lecture 8 hrs.**

Linear Classification, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Perceptron, Support Vector Machines + Kernels, Artificial Neural Networks + Back Propagation, Decision Trees, Bayes Optimal Classifier, Naive Bayes.

Module 4 **Lecture 8 hrs.**

Hypothesis testing, Ensemble Methods, Bagging Adaboost Gradient Boosting, Clustering, K-means, K-medoids, Density-based Hierarchical, Spectral .

Module 5 **Lecture 8 hrs.**

Expectation Maximization, GMMs, Learning theory Intro to Reinforcement Learning , Bayesian Networks.

Suggested books:

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997
2. Introduction to Machine Learning Edition 2, by Ethem Alpaydin

Suggested Reference Books:

1. J. Shavlik and T. Dietterich (Ed), Readings in Machine Learning, Morgan Kaufmann, 1990.
2. P. Langley, Elements of Machine Learning, Morgan Kaufmann, 1995.
3. Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017. [SS-2017]
4. The Elements of Statistical Learning. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Second Edition. 2009. [TH-2009]

Professional Elective – I

	Graph Theory	3L:0T:0P	3 Credits

Detailed contents

Module 1 **Lecture 5 hrs .**

Introduction: What is graph, Application of graphs, Finite and infinite graphs, incidence and degree, isolated Vertex pendant Vertex, and Null graph, paths and circuits, isomorphism, sub graphs, a puzzle with multicolored cubes, walks, paths, and circuits, Connected graphs, disconnected graphs and components, Euler graphs, Operations on graphs, More on Euler graphs, Hamiltonian paths and circuits, The Traveling Salesman problem.

Module 2 **Lecture 5 hrs .**

Trees and Fundamental circuits: Trees, some properties of trees, pendant vertices in a tree, Distance and centers in a tree, Rooted and binary trees, On counting trees, Spanning trees, fundamental circuits, Finding all spanning trees of a Graph, Spanning trees in a Weighted graph.

Module 3 **Lecture 6 hrs.**

Cut set, and cut vertices: Properties of a cut set, all cut sets in a graph, Fundamental circuits and cut sets, connectivity and separability, Network flows, 1-Isomorphism, 2-Isomorphism.

Module 4 **Lecture 4 hrs.**

Planar and Dual Graphs: Combinatorial vs. Geometric Graphs, Planar graph, kuratowski's Two Graphs, Difference Representations of a planar graph, Detection of planarity, Geometric Dual, Combinatorial, Duel, More on criteria of planarity, Thickness and crossings.

Module 5 **Lecture 8 hrs.**

Matrix Representation of Graphs: Incidence Matrix Sub matrices of A(G), Circuits Matrix, Fundamental Circuit Matrix and Rank of B, An application to a switching Network, Cut-set Matrix, Relationships among Af , Bf and Cf . path Matrix, Adjacency Matrix.

Module 6 **Lecture 4 hrs.**

Coloring, Covering and partitioning: Chromatic number, Chromatic partitioning, Chromatics polynomial, Coverings, Four color problem.

Module 7 **Lecture 8 hrs.**

Directed Graphs: What's a directed Graphs, Some types of Digraphs, Digraphs and binary Relations, Directed paths and connectedness, Euler Digraphs, Trees with Directed Edges, Fundamental Circuits in Digraphs, Matrices A, B and C of Digraphs, Adjacency Matrix of a Digraph, Paired Comparisons and Tournaments, Acyclic Digraphs and Decyelization.

Text Book:

1. Douglas B. West, "Introduction to Graph Theory", Prentice Hall of India
2. Deo, N: Graph theory, PHI

Reference Books:

1. Bondy and Murthy: Graph theory and application. Addison Wesley.
2. R. Diestel, "Graph Theory", Springer-Verlag, 2nd edition, 2000.
3. John M. Aldous and Robin J. Wilson: Graphs and Applications-An Introductory Approach, Springer
4. Robin J, Wilson: Introduction to Graph Theory, Addison Wesley.
5. Frank Harary, "Graph Theory", Narosa.
6. R. Ahuja, T. Magnanti, and J. Orlin, "Network Flows: Theory, Algorithms, and Applications", Prentice-Hall

Course Outcomes

At the end of this course, students will demonstrate the ability to

1. Write precise and accurate mathematical definitions of objects in graph theory;
2. Use mathematical definitions to identify and construct examples and to distinguish examples from non-examples;
3. Validate and critically assess a mathematical proof;
4. Use a combination of theoretical knowledge and independent mathematical thinking in creative investigation of questions in graph theory;
5. Reason from definitions to construct mathematical proofs; 6. Write about graph theory in a coherent and technically accurate manner.

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Professional Elective – I

	Signals and Systems	**3L:0T:0P**	**3 Credits**

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of continuous time and discrete time systems.
2. Analyse systems in complex frequency domain. 3. Understand sampling theorem and its implications.

Detailed contents

Module 1 **Lecture: 3 hrs.**

Introduction to Signals and Systems: Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity, additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

Module 2 **Lecture: 8 hrs.**

Behavior of continuous and discrete-time LTI systems: Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

Module 3 **Lecture: 10 hrs.**

Fourier, Laplace and z- Transforms: Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

Module 4 **Lecture: 4 hrs.**

Sampling and Reconstruction: The Sampling Theorem and its implications Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Suggested books:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, “Signals and systems”, Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, Pearson, 2006.
3. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley andSons, 2007.

5. A. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, Prentice Hall, 2009.
6. M. J. Robert “Fundamentals of Signals and Systems”, McGraw HillEducation, 2007. 7. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009.

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Professional Elective – I

	Computer Graphics	**3L:0T:0P**	**3 Credits**

Detailed contents

Module 1 **Lectures: 8 hrs.**

Introduction and Line Generation: Types of computer graphics, Graphic Displays- Random scan displays, Raster scan displays, Frame buffer and video controller. RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software.

Module 2 **Lectures: 8 hrs.**

Points and lines, Line drawing algorithms; DDA algorithm, Bresenham’s line algorithm, Circle generating algorithms, Mid-point circle generating algorithm, and parallel version of these algorithms. Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm. Transformations: Basic transformation, Matrix representations and homogenous coordinates, Composite transformations, Reflections and shearing.

Module 3 **Lectures: 10 hrs.**

Windowing and Clipping: Viewing pipeline, Viewing transformations, 2-D Clipping algorithms- Line clipping algorithms such as Cohen Sutherland line clipping algorithm, Liang Barsky algorithm, Line clipping against non-rectangular clip windows; Polygon clipping – Sutherland Hodgeman polygon clipping, Weiler and Atherton polygon clipping, Curve clipping, Text clipping

Three Dimensional: 3-D Geometric Primitives, 3-D Object representation, 3-D Transformation, 3-D viewing, projections, 3-D Clipping.

Module 4 **Lectures: 8 hrs.**

Curves and Surfaces: Quadric surfaces, Spheres, Ellipsoid, Blobby objects, introductory concepts of Spline, Bspline and Bezier curves and surfaces.

Module 5 **Lectures: 8 hrs.**

Hidden Lines and Surfaces: Back Face Detection algorithm, Depth buffer method, A- buffer method, Scan line method, basic illumination models– Ambient light, Diffuse reflection, Specular reflection

and Phong model, Combined approach, Warn model, Intensity Attenuation, Color consideration, Transparency and Shadows.

Reference Books:

1. Donald Hearn and M Pauline Baker, "Computer Graphics C Version", Pearson Education
2. Foley, Vandam, Feiner, Hughes – "Computer Graphics principle", Pearson Education.
3. Rogers, " Procedural Elements of Computer Graphics", McGraw Hill
4. Donald Hearn and M Pauline Baker, "Computer Graphics with OpenGL", Pearson education

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Professional Elective – I

	Probability and Statistical Inference	**3L:0T:0P**	**3 Credits**

Detailed contents

Module 1 **Lectures: 6 hrs.**

Probability: Properties of Probability, Methods of Enumeration, Conditional Probability, Independent Events, Bayes' Theorem.

Module 2 **Lectures: 6 hrs.**

Discrete Distributions: Random Variables of the Discrete Type, Mathematical Expectation, Special Mathematical Expectations, the Binomial Distribution, the Negative Binomial Distribution, the Poisson distribution.

Module 3 **Lectures: 6 hrs.**

Continuous Distributions: Random Variables of the Continuous Type, the Exponential, Gamma, and Chi-Square Distributions, the Normal Distribution, Additional Models.

Module 4 **Lectures: 6 hrs.**

Bivariate Distributions: Bivariate Distributions of the Discrete Type, the Correlation Coefficient, Conditional Distributions, Bivariate Distributions of the Continuous Type, the Bivariate Normal Distribution.

Module 5 **Lectures: 6 hrs.**

Distributions of Functions of Random Variables: Functions of One Random Variable, Transformations of Two Random Variables, Several Random Variables, The Moment-Generating Function Technique, Random Functions Associated with Normal Distributions, The Central Limit Theorem, Approximations for Discrete Distributions, Chebyshev's Inequality and Convergence in Probability, Limiting Moment-Generating Functions.

Module 6 **Lectures: 6 hrs.**

Point Estimation: Descriptive Statistics, Exploratory Data Analysis, Order Statistics, Maximum Likelihood Estimation, A Simple Regression Problem, Asymptotic Distributions of Maximum Likelihood Estimators, Sufficient Statistics, Bayesian Estimation, More Bayesian Concepts.

Module 7 **Lectures: 6 hrs.**

Interval Estimation: Confidence Intervals for Means, Confidence Intervals for the Difference of Two Means, Confidence Intervals For Proportions, Sample Size, Distribution-Free Confidence Intervals for Percentiles, More Regression, Resampling Methods.

Text Book:

1. "Probability And Statistical Inference", Robert V. Hogg, Elliot A. Tanis, Dale L. Zimmerman; Pearson Education, Inc. Ninth Edition-2015.

Reference Books:

1. "Statistical Inference", M. Rajagopalan, P. Dhanavanthan, PHI Learning – 2012
2. "Probability Distribution Theory and Statistical Inference", Kartick Chandra Bhuyan, NCBA Publication - 2010.

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Professional Elective – I

	Introduction To Java Programming Language	**3L:0T:0P**	**3 Credits**

Detailed contents

Module 1 **Lectures: 12 hrs.**

Introduction to Java: Feature to Java, Java Virtual Machine, Differences between C++ and Java, Part of Java, API Document, Starting a Java Program. Important Classes, Formatting the Output

Naming Conventions and Data Types: Naming Conventions in Java. Data types in Java, Literals.

Operators and Control Statements in Java: Arithmetic Operators, Unary Operators, Relational Operators, Logical Operators, Boolean Operators, Bitwise Operators, Ternary Operators, New Operator, Cast Operator, If … else statement, Switch statement, Break statement, Continue statement, Return statement, do … while loop, while loop, for loop.

Input and Output: Accepting Input from the keyboard, reading input in Java, Util, Scanner class, displaying output with System.out.print(), Displaying formatted output with string, Format.

Module 2 **Lectures: 8 hrs.**

Arrays and Strings: Types of Arrays, Array name, Length, Command Line Arguments, Creating Strings, String Class Methods, String Comparison, Immutability of Strings, Creating String Buffer Objects, String Buffer Class Methods, String Builder Class, String Builder Class Methods.

Wrapper Classes: Number class, Character class, Byte class, Short class, Integer class, Long class, Float class, Double class, Boolean class, Math class.

Introduction to OOPS: Problems in procedure oriented approach, Features of Object Oriented Programming System, Object creation, Initializing the instance variable, Constructors.

Module 3 **Lectures: 10 hrs.**

Methods of Java: Method Prototype, Method Body, Understanding Methods, Static Methods, Static Block, The keyword 'this', Instance Methods, Passing Primitive Data Types to Methods, Passing Objects to Methods, Passing Arrays to Methods, Recursion, Factory Methods.

Inheritance and Polymorphism: Inheritance, The Keyword 'super', The Protected Specified, Types of

Inheritance, Polymorphism with variables, Polymorphism using methods, Polymorphism with Static Methods, Polymorphism with Private Methods, Abstract Classes.

Packages: Package, Different types of Packages, Interface in a Package, Access Specifies in Java.

Module 4 **Lectures: 10 hrs.**

Exceptional handling: Errors in Java Program, Exceptions throws and throw clause, Types of exceptions, Re-throwing an exception.

Threads: Single and Multitasking, Creating and terminating the thread, Single and Multi-tasking using threads, Deadlock of threads, Thread communication.

Introduction to AWT and Applets: AWT components, Creating and closing the frame, Drawing in the frame, Displaying dots and text in the frame, Event Handling, Listeners and Listener methods, Creating and uses of Applets, An applet with swing components, Applet parameters.

Introduction on Java database connectivity: Database servers and clients, JDBC, Connecting to a Database, Stored Procedures and Callable Statement, Storing file and Image into database, retrieving a file and images from database, Types of JDBC drivers.

Text Books:

1. Core Java by R Nageswara & Kogent Solution Inc, Dreamtech.
2. The Complete Reference Java Tata McGraw Hill. 3. Java 6 Programming Black Book, w/CD by Kogent Solutions Inc,, Dreamtech .

Reference Books:

1. Professional Java, JDK 6 Ed. by Richardson Avondolio Wrox. 2.
Programming with Java by E Balagurusamy Tata McGraw Hill.

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Professional Elective – II

	Distributed Database	**3L:0T:0P**	**3 Credits**

Detailed contents

Module 1 **Lectures: 6 hrs.**

Concept And Overview Distributed Database System: What is Distributed Database System (DDBS), Features of DDBS, promises of DDBS, Design issue in DDBS, Distributed DBMS architecture:- Client/server System, Peer-to-Peer, Multi-Database system.

Module 2 **Lectures: 6 hrs.**

Distributed Database Design: Distributed database design concept, objective of Data Distribution, Data Fragmentation, The allocation of fragment, Transparencies in Distributed Database Design.

Module 3 **Lectures: 6 hrs.**

Distributed Transaction And Concurrency Control: Basic concept of Transaction management, objective Distributed transaction management, Model for Transaction management Distributed Concurrency control:- Objective, concurrency control anomalies, Distributed Serializability, Locking based algorithm.

Module 4 **Lectures: 6 hrs.**

Distributed Deadlock and Recovery: Introduction to Deadlock, Distributed Deadlock prevention, avoidance, detection and recovery, Two-Phase and Three-Phase Commit Protocol.

Module 5 **Lectures: 6 hrs.**

Distributed Query Processing And Optimization: Concepts, objective, and phases of distributed query processing; join strategies in fragment relation, Global query optimization

Module 6 **Lectures: 6 hrs.**

Heterogeneous Database: Architecture of Heterogeneous Database, Database Integration: Schema Translation and schema Integration, Query processing issues in Heterogeneous database.

Module 7 **Lectures: 6 hrs.**

XML: XML for data integration, structure of XML, XML document schema, Querying and Transformation, storage of XML data, XML application.

Reference Books:

1. Silberschatz A, KorthHF, Sudarshan S, Database System Concepts, McGrall Hill. 2.
Ceri S, Pelagatti G, Distributed Databases – Principles and Systems, McGraw Hill.

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Professional Elective – II

	Cryptography & Network Security	**3L:0T:0P**	**3 Credits**

Detailed contents

Module 1 **Lectures: 7 hrs**.

Security Services, Mechanisms and Attacks, TheOSI Security Architecture, A Model for Network Security. Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotol Machines, Steganography.

Module 2 **Lectures: 7 hrs**.

Simplified DES, Block Cipher Principles, The Data Encryption Standard, The Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles, Block Cipher Modes of Operation.

Module 3 **Lectures: 7 hrs**.

Finite Fields and Confidentiality: Groups, Rings, and Fields, Modular Arithmetic, Euclid's Algorithm, Finite Fields of the Form GF (p), Polynomial arithmetic, Finite Fields of the Form GF(2"), Placement of Encryption Function, Traffic Confidentially, Key Distribution, Random Number Generation.

Module 4 **Lectures: 7 hrs**.

Encryption Standard and Ciphers: Evaluation criteria for AES, AES cipher, Multiple encryption and Triple DES, Block cipher Modes of operation, Stream ciphers and RCG.

Module 5 **Lectures: 7 hrs**.

Number Theory and Public-Key Cryptography: Prime Numbers, Fermat's and Euler's Theorems, Testing for Primality, The Chinese Remainder Theorem, Discrete Logarithms, Principles of Public-Key Cryptosystems, The RSA Algorithm,

Module 6 **Lectures: 7 hrs**.

Message Authentication, Function, Algorithms and Digital System: Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and MACs, Secure Hash Algorithm, HMAC, Digital Signatures, Authentication Protocols.

Text Book:

1. W.Stallings : Cryptography and Network Security : Principles and Practice, 4/e Pearson Education, New Delhi, 2006. **Reference Books:**
1. B.A. Forouzan – Cryptography and Network Security, TMH, New Delhi, 2007 2.
B. Schneier – Applied Cryptography, John Wiley, Indian Edition, 2006.

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Professional Elective – II

	Advanced Computer Architecture	**3L:0T:0P**	**3 Credits**

Detailed contents

Module 1 **Lectures: 8 hrs**.

Classes of computers, Trends in technology, power and costs, dependability, quantitative principles of computer design, Introduction to computing models.

Module 2 **Lectures: 10 hrs**.

Principles of scalable performance, performance metrics and measures, speedup performance laws, advanced processor technology, super scalar and VLIW processors, Verified memory, cache memory organizations, shared memory organizations. Memory hierarchy, cache performance, protection and examples of virtual memory, cache coherence.

Module 3 **Lectures: 8 hrs**.

Pipeline and superscalar techniques, linear pipeline processors, reservation and latency analysis, collision free scheduling, pipeline schedule optimization, instruction pipeline design, arithmetic pipeline design, super scalar and super pipeline design.

Module 4 **Lectures: 7 hrs**.

Multiprocessors and multi-computers, Brief overview of SIMD, MIMD, vector architectures and multi-core architectures.

Module 5 **Lectures: 7 hrs**.

Elementary theory about dependence analysis, techniques for extraction of parallelism, branch prediction, dynamic scheduling, multiple issue and speculation, limits on instruction level parallelism, Thread level parallelism

Reference Books:

1. Computer Architecture: A Quantitative Approach : Hennessy and Patterson : Morgan Kaufmann
2. Advanced Computer Architecture, Kai Hwang , McGraw Hill
3. Advanced Computer Architectures : A design space approach, Sima D, Fountain T. and Kacsuk P, Pearson Education

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Professional Elective – II

	Multimedia Technology and its Applications	**3L:0T:0P**	**3 Credits**

Detailed contents

Module 1: Introduction to Multimedia System **Lectures: 6 hrs**.

Architecture and components, Multimedia distributed processing model, Synchronization, Orchestration and Quality of Service (QOS) architecture.

Module 2: Audio and Speech **Lectures: 8 hrs**.

Data acquisition, Sampling and Quantization, Human Speech production mechanism, Digital model of speech production, Analysis and synthesis, Psycho-acoustics, low bit rate speech compression, MPEG audio compression.

Module 3: Images and Video **Lectures: 8 hrs**.

Image acquisition and representation, Composite video signal NTSC, PAL and SECAM video standards, Bi-level image compression standards: ITU (formerly CCITT) Group III and IV standards, JPEG image compression standards, MPEG video compression standards.

Module 4: Multimedia Communication **Lectures: 6 hrs**.

Fundamentals of data communication and networking, Bandwidth requirements of different media, Real time constraints: Audio latency, Video data rate, multimedia over LAN and WAN, Multimedia conferencing, Multimedia devices.

Module 5: Hypermedia presentation **Lectures: 6 hrs**.

Authoring and Publishing, Linear and non-linear presentation, Structuring Information, Different approaches of authoring hypermedia documents, Hyper-media data models and standards.

Module 6: Multimedia Information Systems **Lectures: 6 hrs**.

Operating system support for continuous media applications: limitations is usual OS, New OS support, Media stream protocol, file system support for continuous media, data models for multimedia and hypermedia information, content based retrieval of unstructured data.

Text Books

1. Handbook of Multimedia Computing, Borivoje Furht
2. Multimedia Systems, Standards, and Networks, A. Puri and T. Chen, Marcel Dekker
3. Multimedia : Computing Communications & Applications, Ralf Steinmetz, Klara Nahrstedtm

Reference Books

a. Multimedia Systems, Ralf Steinmetz and Klara Nahrstedt
b. Multimedia Communications: Directions and Innovations, J. D. Gibson
c. Introduction to Data Compression, Morgan-Kaufmann, K. Sayood
d. H.264 and MPEG-4 Video Compression, Iain E.G. Richardson
e. Multimedia Literacy by Fred Hoffsteller, McGraw Hill.

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Professional Elective – II

	Advance Java Programming	**3L:0T:0P**	**3 Credits**

Detailed contents

Module 1 **Lectures: 8 hrs**.

Java Beans and Web Servers: Introduction to Java Beans, Advantage, Properties, BDK, Introduction to EJB, Java Beans API Introduction to Servelets, Lifecycle, JSDK, Servlet API, Servlet Packages: HTTP package, Working with Http request and response, Security Issues. Java Script: Data types, variables, operators, conditional statements, array object, date object, string object, Dynamic Positioning and front end validation, Event Handling

Module 2 **Lectures: 8 hrs**.

JSP: Introduction to JSP, JSP processing, JSP Application Design, Tomcat Server, Implicit JSP objects, Conditional Processing, Declaring variables and methods, Error Handling and Debugging, Sharing data between JSP pages- Sharing Session and Application Data.

Module 3 **Lectures: 8 hrs**.

Database Connectivity: Database Programming using JDBC, Studying Javax.sql.*package, accessing a database from a JSP page, Application-specific Database Action, Developing Java Beans in a JSP page, introduction to Struts framework.

Module 4 **Lectures: 8 hrs**.

Java Servlet: Brief origin and advantages over CGI, J2EE Servlet 2.x Specification, Writing small Servlet Programs, Deployment Descriptor, Inter Servlet Collaboration, Session: Definition, State on web, Different ways to track sessions,

Module 5 **Lectures: 8 hrs**.

J2SE: Concepts and Prerequisites: Data Types, Arrays, Dynamic Arrays, Type Casting, Classes and Objects, Inheritance, Interfaces, Exception Handling, Multi-Threading, **J2EE** Architecture: J2EE as a framework, Client Server Traditional model, Comparison amongst 2-tier, 3-tier and N- tier architectures, Thin and Thick Clients

Text Books:

1. Elliotte Rusty Harold, " Java Network Programming", O'Reilly publishers,
2. Ed Roman, "Mastering Enterprise Java Beans", John Wiley & Sons Inc.
3. Hortsmann& Cornell, "Core Java 2 Advanced Features, Vol II", Pearson Education,

References:

1. Web reference: http://java.sun.com. 2. Patrick Naughton, "COMPLETE REFERENCE: JAVA2", Tata McGraw-Hill.

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Professional Elective – II

	Data Science	**3L:0T:0P**	**3 Credits**

Objectives of the course

The objective of this course is to impart necessary knowledge of the mathematical foundations needed for data science and develop programming skills required to build data science applications.

Detailed Contents

Module 1 **Lecture 4 hrs.**

1. Introduction to Data Science: Concept of Data Science, Traits of Big data, Web Scraping, Analysis vs Reporting

Module 2 **Lecture 6 hrs.**

2. Introduction to Programming Tools for Data Science

2.1 Toolkits using Python: Matplotlib, NumPy, Scikit-learn, NLTK

2.2 Visualizing Data: Bar Charts, Line Charts, Scatterplots

2.3 Working with data: Reading Files, Scraping the Web, Using APIs (Example: Using the Twitter APIs), Cleaning and Munging, Manipulating Data, Rescaling, Dimensionality Reduction

Module 3 **Lecture 12 hrs.**

3. Mathematical Foundations

3.1 Linear Algebra: Vectors, Matrices,

3.2 Statistics: Describing a Single Set of Data, Correlation, Simpson's Paradox, Correlation and Causation

3.3 Probability: Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, The Central Limit Theorem

3.4 Hypothesis and Inference: Statistical Hypothesis Testing, Confidence Intervals, Phacking, Bayesian Inference

Module 4 **Lecture 16 hrs.**

4. Machine Learning

Overview of Machine learning concepts – Over fitting and train/test splits, Types of Machine learning – Supervised, Unsupervised, Reinforced learning, Introduction to Bayes Theorem, Linear Regression- model assumptions, regularization (lasso, ridge, elastic net), Classification and Regression algorithms- Naïve Bayes, K-Nearest Neighbors, logistic regression, support vector machines (SVM), decision trees, and random forest, Classification Errors, Analysis of Time Series-Linear Systems Analysis, Nonlinear Dynamics, Rule Induction, Neural Networks Learning And Generalization, Overview of Deep Learning.

Module 5 **Lecture 6 hrs.**

5. Case Studies of Data Science Application

Weather forecasting, Stock market prediction, Object recognition, Real Time Sentiment Analysis.

6. List of Practicals

i. Write a programme in Python to predict the class of the flower based on available attributes.

ii. Write a programme in Python to predict if a loan will get approved or not. iii. Write a programme in Python to predict the traffic on a new mode of transport. iv. Write a programme in Python to predict the class of user.

v. Write a programme in Python to indentify the tweets which are hate tweets and which are not.

vi. Write a programme in Python to predict the age of the actors.

vii. Mini project to predict the time taken to solve a problem given the current status of the user.

Reference Books:

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition, O'Reilly Media
3. Jain V.K., “Data Sciences”, Khanna Publishing House, Delhi.
4. Jain V.K., “Big Data and Hadoop”, Khanna Publishing House, Delhi.
5. Jeeva Jose, “Machine Learning”, Khanna Publishing House, Delhi.
6. Chopra Rajiv, “Machine Learning”, Khanna Publishing House, Delhi.
7. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press http://www.deeplearningbook.org
8. Jiawei Han and Jian Pei, "Data Mining Concepts and Techniques", Third Edition, Morgan Kaufmann

Publishers

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Professional Elective – II

	Web and Internet Technology	**3L:0T:0P**	**3 Credits**

Objective of the course: This course is intended to teach the basics involved in publishing content on the World Wide Web. This includes the ‘language of the Web’ – HTML, the fundamentals of graphic production with a specific stress on creating graphics for the Web, and a general grounding introduction to more advanced topics such as programming and scripting. This will also expose students to the basic tools and applications used in Web publishing.

Detailed contents

Module 1 **Lectures: 5 hrs.**

Web Basics: Introduction, Concept of Internet- History of Internet, Protocols of Internet, World Wide Web, URL, Web Server, Web Browser. Recent Web technologies - A case study on WWW, web 2.0 etc., Client/Server Computing: C/S Computing, Middleware, Fat client VS Fat Servers, N- tiered Software Architecture; Markup-language: Markup Languages and their grammars - SGML, DTD Resources, HTML, CSS, XML, XSL, Query Languages for XML.

Module 2 **Lectures: 4 hrs.**

HTML: Introduction, History of HTML, Structure of HTML Document: Text Basics, Structure of HTML Document: Images and Multimedia, Links and webs, Document Layout, Cascading Style Sheet- HTML 4 style sheet features, Creating Forms, Frames and Tables.

Module 3 **Lectures: 3 hrs.**

Dynamic HTML: Introduction of DHTML- HTML vs. DHTML, Advantages of DHTML, CSS of DHTML, Event Handling, Data Binding, Browser Object Models.

Module 4 **Lectures: 6 hrs.**

XML Introduction and programming: Introduction of XML- Some current applications of XML, Features of XML, Anatomy of XML document, The XML Declaration, Element Tags- Nesting and structure, XML text and text formatting element, Table element, Mark-up Element and Attributes, Document Type Definition (DTD), types. XML Programming- XML Objects, Checking Validity, Understanding XLinks, XPointer, Event-driven Programming, XML Scripting.

Module 5 **Lectures: 5 hrs.**

XML Presentation Technology & XML Processor: Introduction, XML with Style Sheet Technologies- Concept of XSL, XML Schema, Importance of XML schema, Creating Element in XML Schema, XML Schema Types, Introduction of XML Processor- Components of XML processor, Concept of DOM and SAX, Introduction of Java Script, JavaScript characteristics, Objects in Java Script, Dynamic HTML with Java Script

Module 6 **Lectures: 4 hrs.**

XMLHttpRequest: Introduction, XMLHttpRequest, The XMLHttpRequest Object, Events for the XMLHttpRequest Object, Request Object for XMLHttpRequest, Response Object for XMLHttpRequest.

Module 7 **Lectures: 3 hrs.**

AJAX Introduction: Introduction, AJAX Introduction, AJAX Components, Handling Dynamic HTML with Ajax, CSS to Define Look and Feel, Understand the XML Mark-up, XMLHttpRequest.

Module 8 **Lectures: 4 hrs.**

AJAX using XML and XML Http Request: Introduction, Ajax Using XML and XML Http Request, Accessing, Creating and Modifying XML Nodes, Loading XML Data into an HTML Page, Receiving XML Responses, Handling Response XML.

Module 9 **Lectures: 4 hrs.**

PHP Introduction & AJAX with Database: PHP Introduction, Structure of PHP, PHP Functions, AJAX with PHP, PHP Code and the Complete AJAX Example, AJAX Database, Working of AJAX with PHP, Ajax PHP Database Form, AJAX PHP MySQL Select Query.

Module 10 **Lectures: 4 hrs.**

Active Server Page & ASP Database Connectivity : Introduction, Introduction of ASP, ASP Variables, ASP Control Structure, ASP Objects' Properties and Methods, ASP Components, ASP Database Connection, ASP Scripting Components.

Text Book:

1. Jeffrey C. Jackson, "Web Technologies: A computer science perspective", Pearson Education
2. Developing Web Applications, Ralph Moseley and M. T. Savaliya, Wiley-India
3. Web Technologies, Black Book, dreamtech Press
4. Web Design, Joel Sklar, Cengage Learning
5. Developing Web Applications in PHP and AJAX, Harwani, McGrawHill

Reference Books:

1. Eric T. Freeman, Elisabeth Robson, "Head First JavaScript Programming", O'Reilly Media
2. L. Beighley, Michael Morrison, "Head First PHP & MySQL", O-Reilly Media
3. B. Basham, Kathy Sierra, Bert Bates, "Head First Servlets and JSP", O'Reilly publication.
4. R. M. Riordan, "Head First Ajax", O'Reilly Media.
5. Web Design with HTML, CSS, JavaScript and Query Set by Jon Duckett

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