Department of INFORMATION TECHNOLOGY

R.V.R. &J.C. COLLEGE OF ENGINEERING (A) :: GUNTUR – 522019.

PROPOSED SCHEME OF EXAMINATION AND INSTRUCTION FOR M.TECH(CST) w.e.f 2021-22

I/II M.TECH (COMPUTER SCIENCE & TECHNOLOGY) :: FIRST SEMESTER

Sl. No	Code No & Subject	Hours/Week		Credits	Evaluation of Marks			
		Lecture	Practical		Internal	External		Total
						Theory	Practical	
1	CT511 – Advanced Data Structures and Algorithms	4	--	4	40	60	--	100
2	CT512– Advanced Database Management Systems	4	--	4	40	60	--	100
3	CT513– Advanced Operating Systems	4	--	4	40	60	--	100
4	Elective – I	4	--	4	40	60	--	100
5	Elective – II	4	--	4	40	60	--	100
6	Elective – III	4	--	4	40	60	--	100
7	CT551– Advanced Programming Lab	--	3	2	40	--	60	100
8	CT552– Advanced Database Management Systems Lab	--	3	2	40	--	60	100
TOTAL		24	6	28	320	360	120	800

I/II M.TECH (COMPUTER SCIENCE & TECHNOLOGY):: SECOND SEMESTER

Sl. No	Code No & Subject	Hours/Week		Credits	Evaluation of Marks			
		Lecture	Practical		Internal	External		Total
						Theory	Practical	
1	CT521 – Number Theory and Cryptography	4	--	4	40	60	--	100
2	CT522 –TCP/IP	4	--	4	40	60	--	100
3	CT523 –Machine Learning	4	--	4	40	60	--	100
4	Elective-IV	4	--	4	40	60	--	100
5	Elective-V	4	--	4	40	60	--	100
6	Elective- VI	4	--	4	40	60	--	100
7	CT MC01– Research Methodology and IPR	2	--	-	100	-	--	100
8	CT561 –Machine Learning Lab	--	3	2	40	--	60	100
9	CT562 – Industry Related Lab	--	3	2	40	--	60	100
TOTAL		24	6	28	420	360	120	900

II/II M.TECH (COMPUTER SCIENCE & TECHNOLOGY) :: FIRST SEMESTER

Sl. No	Code No & Subject	Hours/Week		Credits	Evaluation of Marks		
		Lecture	Practical		Internal	External	Total
1	CT 651 – MOOCS	--	--	2	--	--	--
2	CT 652 – Summer Internship	--	--	2	100	--	100
3	CT 653 – Project Phase - I	--	--	4	100	--	100
TOTAL		--	--	8	200	--	200

II/II M.TECH (COMPUTER SCIENCE & TECHNOLOGY) :: SECOND SEMESTER

Sl. No	Code No & Subject	Hours/Week		Credits	Evaluation of Marks		
		Lecture	Practical		Internal	External	Total
1	CT 661 – Project Phase - II	--	--	10	40	60	100

TOTAL MARKS: 2000 **TOTAL: 74 Credits**

Proposed Electives:

1. CT571 – Automata and Compiler Design
2. CT572 – Advanced Computer Architecture
3. CT573 – Advanced Web Technologies
4. CT574 – Advanced Software Engineering
5. CT575 – Artificial Intelligence
6. CT576 – Digital Image Processing
7. CT577 – Block Chain Technology
8. CT578 - Quantum Computing and Information Theory
9. CT579 – Information Security
10. CT580 – AR & VR
11. CT581 – Wireless Networks
12. CT582 – Deep Learning
13. CT583 – Big Data Analytics
14. CT584 – Cloud Computing
15. CT585 – Internet of Things
16. CT586 – Mobile Computing
17. CT587 – Agile Software Development
18. CT588 – Data Engineering
19. CT589 – Evolutionary Computation
20. CT590 – Parallel Algorithms
21. CT591 – Fuzzy Set Theory and Applications
22. CT592 – Natural Language Processing
23. CT593 – Software Architecture
24. CT594 – Semantic Web

RVR & JC COLLEGE OF ENGINEERING:: GUNTUR
M.Tech(Computer Science & Technology)
Syllabus w.e.f. 2021-22
CT 511 – Advanced Data Structures and Algorithms

Lecture: 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 4

Course Learning Objectives: At the end of the Course Students will understand

1. Fundamentals of analysis of algorithm at depth.
2. Study of advanced data structures and its uses.
3. Analysis of problems from different domains.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Identify and use suitable data structures for given problem from different domains.
2. Appreciate the role of Graph algorithms in solving variety of problems.
3. Appreciate the role of Optimization by using linear programming.
4. Analyze the various algorithms from different domains.
5. Understand the importance of advanced algorithms and techniques.

UNIT – I: **[9 Periods]**

Introduction, Asymptotic notations Big O, Big Θ, Big Ω, o, ω notations, Proofs of master theorem, applying theorem to solve problems.

UNIT – II: **[9 Periods]**

Advanced Data Structures Red-Black Trees: properties of red-black trees, Insertions, Deletions B-Trees and its operations Binomial Heaps: Binomial trees and binomial heaps, Operation on Binomial heaps.

UNIT - III : **[9 Periods]**

Dynamic Programming matrix chain multiplication, cutting rod problem and its analysis Graph Algorithms Bellman ford algorithm, Dijkstra algorithm, Johnson's All pair shortest path algorithm for sparse graphs.

UNIT – IV: **[9 Periods]**

Maximum Flow, Flow networks, the ford Fulkerson method, max bipartite matching, push Relabel Algorithm, the relabel to front algorithm

UNIT – V : **[9 Periods]**

Linear Programming Standard and slack forms, Formulating problems as linear programs, simplex algorithm, Duality, Initial basic feasible solution.

Text Books:

1. T.H. Coreman , C.E. Leiserson, R.L. Rivest, and C. Stein, “Introduction to algorithms”,2nd edition, PHI publication 2005.
2. Ellis Horowitz, SartajSahni , S. Rajsekaran. “Fundamentals of computer algorithms” University Press.

References:

1. Robert Sedgewick Philippe Flajolet, “An Introduction to the Analysis of Algorithms”, First Edition, McGraw Hill, 1995.
2. G.A.V. Pai, “Data Structures and Algorithms”, TMH, 2009.

CT 512 – Advanced Database Management Systems

Lecture : 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 4

Course Learning Objectives: At the end of the Course Students will understand

1. Fundamental Concepts of Standard and Advanced Databases.
2. Active databases, Knowledge Based Systems(KBSs), Deductive Databases, and Relation Ship between KBSs and DBMSs.
3. Advance solutions for KBSs, Temporal Databases, Multimedia Databases, Ontology and Data Mining.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Use Data Models and understand the Database Context.
2. Know the importance of Active Database systems and it role in the context of Knowledge Based systems.
3. Apply Deductive databases and its coupling to knowledge based systems.
4. Acquire the knowledge of Temporal Databases used in the latest technologies.
5. Know the Internet retrieval and Indexing mechanisms.

UNIT – I: **[9 Periods]**

Relational Databases: Integrity Constraints, Functional Dependency, Multi-valued Dependency; Query Processing and Optimization: Evaluation of Relational Operations, Transformation of Relational Expressions, Indexing and Query Optimization, Data access from disk, Index based access, Sort and Join Processing, Physical plan selection, Limitations of Relational Data Model;

UNIT— II: **[9 Periods]**

Parallel and Distributed Databases: Distributed Data Storage, Fragmentation & Replication, Location and Fragment Transparency, Distributed Query Processing and Optimization, Distributed Transaction, Modeling and Concurrency Control, Distributed Deadlock, Commit Protocols

UNIT – III: **[9 Periods]**

Advanced Transaction Processing: Nested and Multilevel Transactions, Compensating Transactions and Saga, Long Duration Transactions, Weak Levels of Consistency, Transaction Work Flows, Transaction Processing Monitors;

UNIT – IV: **[9 Periods]**

Objected Oriented and Object Relational Databases: Modeling Complex Data Semantics, Specialization, Generalization, Aggregation and Association, Objects, Object Identity, Equality and Object Reference, Architecture of Object Oriented and Object Relational Databases

Unit – V: **[9 Periods]**

NoSQL databases: Cassandra, MongoDB, etc.,

References:

1. Avi Silberschatz, Henry F. Korth & S. Sudarshan, “Database System Concepts”, Tata McGraw-Hill.

2. W. Kim, “Introduction to Object Oriented Databases”, MIT Press.

3. J. D. Ullman, “Principles of Database and Knowledge Base Systems”, Computer Science Press

CT 513 – Advanced Operating Systems

Lecture : 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 4

Course Learning Objectives: At the end of the Course Students will understand

1. Fundamentals of Scheduling and Inter process Communication.
2. Concepts of Files, File systems, Devices and Device Drivers.
3. Concepts of Resource management and Security.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Analyze, design and implement different scheduling algorithms.
2. Design and implement inter process communication mechanisms and synchronization problems in Uni-processor and multiprocessor systems.
3. Use files and files systems in UNIX environment.
4. Understand and use the concepts of devices and device drivers.
5. Understand Resource Management and Security Issues for protection.

UNIT – I: **[9 Periods]**

PROCESSES AND SCHEDULING: Process States and System Call Interface; Life Cycle of a Process; Process Dynamics; Scheduler; working and implementation; Linux Process States and System Calls; Process Groups, Sessions, Foreground and Background Processes.

UNIT – II: **[9 Periods]**

INTERPROCESS COMMUNICATION AND SYNCHRONISATION: Signals, Pipes and Named Pipes (FIFOs); Threads and pthread library; Mutexes and Condition Variables; Semaphores; Producer-Consumer Problem and Solutions using mutexes, condition variables and semaphores.

UNIT – III: **[9 Periods]**

FILES AND FILE SYSTEMS: File and File Meta-data; File Naming Systems; File System Operations; File System Implementation; File System Structures; Booting an OS; File System Optimization.

UNIT – IV: **[9 Periods]**

DEVICES AND DEVICE DRIVERS: Devices and Types of Devices; Terminal, Disk, SCSI, Tape and CD devices; Unification of Files and Devices; Device Drivers; Concepts and Implementation Details.

UNIT – V: **[9 Periods]**

RESOURCE MANAGEMENT AND SECURITY: Resource Management Issues; Types of Resources; Integrated Resource Scheduling; Queuing Models of Scheduling; Protection of Resources – hardware, software, and attacks; Security Policies.

TEXT BOOKS:

1. Charles Crowley, Operating Systems: A Design-Oriented Approach,Tata McGraw-Hill (2001 or later)
2. Richard Stevens, Stephen Rago, Advanced Programming in the Unix Environment, Addison-Wesley (2013).

REFERENCES:

1. Maekawa, M. and Arthur E. Oldehoeft and Oldehoeft, R.R. Operating Systems: Advanced Concepts, Benjamin Cummings (1987)
2. David A.Rusling. The Linux Kernel

CT 521 – Number Theory and Cryptography

Lecture: 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 4

Course Learning Objectives: At the end of the Course Students will understand

1. The fundamentals in number theory, finite fields and quadratic residues.
2. The public key and elliptic curve cryptography.
3. The primality and factoring principles and methods.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Know the concepts of the number theory and the quadratic residues.
2. Know the enciphering matrices and the simple cryptosystems.
3. Familiar with public key cryptography algorithms.
4. Apply the concepts of primality and factoring in cryptosystems.
5. Familiar with elliptic curve cryptography algorithms.

UNIT I: **[9 Periods]**

Some Topics in Elementary Number Theory: Time estimates for doing arithmetic, Divisibility and the Euclidean algorithm, Congruence, Some applications to factoring.

Finite Fields and Quadratic Residues: Finite fields, Quadratic residues and reciprocity

UNIT II: **[9 Periods]**

Cryptography: Some simple cryptosystems, Enciphering matrices.

UNIT III: **[9 Periods]**

Public Key: The idea of public key cryptography, RSA, Discrete log, Knapsack, Zero-knowledge protocols and oblivious transfer.

UNIT IV: **[9 Periods]**

Primality and Factoring: Pseudo primes, the rho method, Fermat factorization and factor base, the continued fraction method, the quadratic sieve method.

UNIT V: **[9 Periods]**

Elliptic Curves: Basic facts, Elliptic curve cryptosystems, Elliptic curve primality test, Elliptic curve factorization.

TEXT BOOK:

1. Neal Koblitz, "A Course in Number Theory and Cryptography", Second Edition, Springer-Verlag.**Reference Books:**
2. M.R. Schroeder, "Number Theory in Science and Communication", Springer; 4th ed. Edition.
3. Douglas R. Stinson, "Cryptography: Theory and Practice", Third Edition, Chapman and Hall/CRC.

CT 522 – TCP/IP

Lecture: 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 4

Course Learning Objectives: At the end of the Course Students will understand

1. To understand the basic concepts of TCP/IP Architecture.
2. To understand about various Routing Network Transport Layer Protocols.
3. To understand the functionalities of various application layer protocols.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. An ability to understand the basic concepts of data communication and responsibility of each layers of reference model
2. Familiarize with network layer.
3. Familiarize with transport layer protocols and its applications.
4. An Ability to understand the client-server model of interaction.
5. An ability to understand the concept of client server technology and remote login protocols

UNIT I : **[9 Periods]**

Introduction and Overview, Review Of Underlying Network Technologies, Internetworking Concept and Architectural Model , Classful Internet Addresses .

UNIT II: **[9 Periods]**

Mapping internet Addresses To Physical Addresses (ARP) , Determining An Internet Address At Startup (RARP) , Internet Protocol: Connectionless Datagram Delivery , Routing IP Datagrams , Error And Control Messages (ICMP) .

UNIT III: **[9 Periods]**

User Datagram Protocol (UDP) , Reliable Stream Transport Service (TCP) , Routing: Cores, Peers, And Algorithms .

UNIT IV: **[9 Periods]**

Client-Server Model Of Interaction, The Socket Interface, TCP/IP over ATM Networks, Mobile IP, DHCP

UNIT V: **[9 Periods]**

Applications: Voice And Video Over IP (RTP), Internet Management (SNMP)

Text Book:

1.Internetworking with TCP/IP, Volume-1, 4/e (Principles, Protocols & Architectures) - Douglas E.Comer, PHI.

References:

1.Internetworking with TCP/IP, Volume-)!, 3/e (Design, Implementation & Internals) - Douglas E-Comer, David L.Stevens., PHI

2.Internetworking with TCP/IP, Volume-ill, 2/e (Client-Server Programming & Applications) - Douglas E.Comer, David L.Stevens. PHI

CT 523 – Machine Learning

Lecture: 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 4

Course Learning Objectives: At the end of the Course Students will understand

1. and know what the goals and objectives of machine learning are how to use machine learning to build real-world systems
2. and have knowledge of popular classification and prediction techniques and learn how to build systems that explore unknown and changing environments
3. and get some exposure to machine learning theory, in particular how learn models that exhibit high accuracies.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. know what the goals and objectives of machine learning are
2. have a basic understanding on how to use machine learning to build real-world systems
3. have sound knowledge of popular classification and prediction techniques, such as decision trees, support vector machines, nearest-neighbor approaches.
4. learn how to build systems that explore unknown and changing environments
5. have some exposure to more advanced topics, such as ensemble approaches, kernel methods, unsupervised learning, feature selection and generation.

Unit-I: **[9 Periods]**

Introduction to Machine Learning. Supervised Learning, Bayesian Decision Theory and Naïve Bayesian Approaches, Parametric Model Estimation.

Unit-II: **[9 Periods]**

Dimensionality Reduction Centering on PCA, Clustering1: Mixture Models, K-Means and EM, Non-Parametric Methods Centering on kNN and Density Estimation.

Unit-III: **[9 Periods]**

Clustering2: Density-based Approaches, Decision and Regression Trees, Comparing Classifiers, Ensembles: Combining Multiple Learners

Unit-IV **[9 Periods]**

Support Vector Machines, More on Kernel Methods,

Unit-V: **[9 Periods]**

Belief Networks, Reinforcement Learning, Neural Networks, Computational Learning Theor**ooks**

Text Books:

1. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 2010.

References:

1. Tom Mitchell, “Machine Learning”, Mc Graw Hill publications, 1997.
2. Christopher. M.Bishop, “Pattern Recognition and Machine Learning”, Springer publications, October, 2007.
3. Ethem Alpaydin, “Introduction to Machine Learning”, 2nd Edition, MIT Publisher, 2010.

CT 524 – Research Methodology and IPR

UNIT-I

Overview of Research Methodology: Mathematical tool for analysis, Types of Research, Research process,

Review of basic statistical measures: measures of central tendency, measures of variation, measure of skewness.

UNIT-II

Probability distributions: Introduction, approaches to probability, probability distributions.

Sampling methods and distributions: sampling distribution of mean when normal population variance is unknown, sampling distributions of variance, confidence interval estimation, determination of sample size.

UNIT-III

Test of Hypothesis: test of hypothesis concerning mean, Test of Hypothesis concerning variances, Chi-square test for checking independence of categorized data, goodness of fit test.

UNIT-IV

Basic multivariate analysis: Correlation analysis.

Design and analysis of experiments: introduction, analysis of variance, completely randomized design, Lattin square design, duncann's multiple range test.

UNIT-V

Advanced multivariate analysis: Discriminant analysis, Factor analysis, terminologies of factor analysis, methods of factor analysis, cluster analysis.

Simulation: Need for simulation, types of simulation, simulation languages.

Prescribed Book: R.Panneerselvan, Research methodology,PHI

Reference Book: C.R.Kothari Research Methodology, Methods and Techniques,Viswaprakasan

CT 571 – Automata and Compiler Design

Lecture : 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 4

Course Learning Objectives: At the end of the Course Students will understand

1. Know the abstract machines and its parsing techniques.
2. Concepts of parsing techniques and language semantics and context sensitive features.
3. Know Runtime storage and code optimization and concepts of code generation.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Understand the concept of abstract machines and their power to recognize the languages.
2. Attains the knowledge of semantics of the language.
3. Know grammars relationship among them with the help of chomsky hierarchy.
4. Understand the design of a compiler given features of the languages.
5. Implement practical aspects of automata theory.

UNIT - I: **[9 Periods]**

FORMAL LANGUAGE AND REGULAR EXPRESSIONS: Languages, Definition Languages regular expressions, Finite Automata – DFA, NFA. Conversion of regular expression to NFA, NFA to DFA. Applications of Finite Automata to lexical analysis, lex tools.

CONTEXT FREE GRAMMARS AND PARSING: Context free grammars, derivation, parse trees, ambiguity LL(K) grammars and LL(1) parsing.

UNIT - II: **[9 Periods]**

Bottom up parsing handle pruning LR Grammar Parsing, LALR parsing, parsing ambiguous grammars, YACC programming specification.

SEMANTICS : Syntax directed translation, S-attributed and L-attributed grammars, Intermediate code – abstract syntax tree, translation of simple statements and control flow statements.

UNIT - III: **[9 Periods]**

CONTEXT SENSITIVE FEATURES: Chomsky hierarchy of languages and recognizers. Type checking, type conversions, equivalence of type expressions, overloading of functions and operations.

UNIT – IV: **[9 Periods]**

RUN TIME STORAGE: Storage organization, storage allocation strategies scope access to how local names, parameters, language facilities for dynamics storage allocation.

CODE OPTIMIZATION: Principal sources of optimization, optimization of basic blocks, peephole optimization, flow graphs, Data flow analysis of flow graphs.

UNIT - V: **[9 Periods]**

CODE GENERATION: Machine dependent code generation, object code forms, generic code generation algorithm, Register allocation and assignment. Using DAG representation of Block.

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TEXT BOOKS:

1. Introduction to Theory of computation, Sipser, 2nd Edition, Thomson.
2. Compilers Principles, Techniques and Tools Aho, Ullman, Ravisethi, Pearson Education.

REFERENCES:

1. Modern Compiler Construction in C , Andrew W.Appel Cambridge University Press.
2. Compiler Construction, LOUDEN, Thomson.
3. Elements of Compiler Design, A. Meduna, Auerbach Publications, Taylor and Francis Group.
4. Principles of Compiler Design, V. Raghavan, TMH.
5. Engineering a Compiler, K. D. Cooper, L. Torczon, ELSEVIER.
6. Introduction to Formal Languages and Automata Theory and Computation - Kamala Krithivasan and Rama R, Pearson.
7. Modern Compiler Design, D. Grune and others, Wiley-India.
8. A Text book on Automata Theory, S. F. B. Nasir, P. K. Srimani, Cambridge Univ. Press.
9. Automata and Language, A. Meduna, Springer.

CT 572 – Advanced Computer Architecture

Lecture : 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 4

Course Learning Objectives: At the end of the Course Students will understand

1. Advanced computer and high performance computing architectures.
2. Concepts of system interconnection architectures and performance measures.
3. Performance issues related to pipelined processors and programming concepts for parallel computers.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Familiarize with the concepts of parallel computer models.
2. Familiarize with interconnection architectures and performance measures for multiprocessors and multi computers.
3. Analyze design structures, instruction level parallelism and dynamic level parallelism with pipelined processors.
4. Familiarize with scalable, multithreaded and dataflow architectures.
5. Know the programming models and code optimization techniques for parallel computers.

UNIT – I: **[12 Periods]**

Parallel Computer Models: The state of computing, Classification of parallel computers, Multiprocessors and Multicomputers, Multivector and SIMD computers.

Program and network properties: Conditions of parallelism, Data and resource Dependences, Hardware and Software parallelism, Program partitioning and scheduling, Grain Size and latency, Program flow mechanisms, Control flow versus data flow, Data flow Architecture, Demand driven mechanisms, Comparisons of flow mechanisms.

UNIT – II: **[12 Periods]**

System Interconnect Architectures: Network properties and routing, Static interconnection Networks, Dynamic interconnection Networks, Multiprocessor system Interconnects, Hierarchical bus systems, Crossbar switch and multi-port memory, Multistage and combining network.

Principles of Scalable Performance: Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws - Amdahl's law for fixed load, Gustafson's law for scaled problems, Memory Bounded Speedup Model.

UNIT-III: **[12 Periods]**

Pipelining: Linear pipeline processor, nonlinear pipeline processor, Instruction pipeline Design, Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch Handling techniques, branch prediction.

Pipelining: Arithmetic Pipeline Design, Computer Arithmetic principles, Static Arithmetic pipeline, Multifunctional arithmetic pipelines.

UNIT –IV: **[12 Periods]**

MULTI Processors: Multiprocessor System Interconnect, Cache Coherence and Synchronization Mechanisms, Message-passing Mechanism.

Scalable, Multi-Threaded and Dataflow Architectures: Latency-Hiding Techniques, Principles of Multithreading, Scalable and Multithreaded Architectures.

UNIT-V: **[12 Periods]**

Parallel Models, Languages and Compilers: Parallel Programming Models, Parallel Languages and Compilers, Dependence analysis of Data Arrays.

Parallel Models, Languages and Compilers: code optimization and Scheduling, Loop parallelization and pipelining.

Text Book:

1. Kai Hwang, "Advanced Computer Architecture", TMH.

Reference Books:

1. D.A. Patterson and J.L.Hennessey, "Computer organization and Design", Morgan Kaufmann, 2nd Edition.
2. V.Rajaram & C.S.R.Murthy, "Parallel Computer", PHI.
3. Barry Wilkinson and Michael Allen, “Parallel Programming” Pearson Education.

CT 573 – Advanced Web Technologies

Lecture : 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 4

Course Learning Objectives: At the end of the course the students will understand

1. The basic concepts to develop dynamic complex web applications.
2. The basic concepts of XML, Web servers, Ruby script and PHP.
3. Java Server side technologies and Semantic Web Concepts.

Course Learning Outcomes: At the end of the course the students will be able to

1. Familiar with Advanced Web technologies.
2. Design dynamic Web documents using client side scripting.
3. Develop XML applications and web documents with ruby script & PHP.
4. Write java server side programs.
5. Familiar with Semantic Web technologies.

UNIT –I: [9 Periods]

Introduction: XHTML, Cascading Style Sheets (CSS), JavaScript: Introduction to Scripting, Control Statements, Functions, Arrays, Objects

UNIT –II: [9 Periods]

Dynamic HTML: Object Model and Collections, Dynamic HTML: Event Model, XML: Introduction, DTD, Schema, XSL

UNIT –III: [12 Periods]

Web Servers: (IIS and Apache), Ruby on Rails, PHP: Introduction, Using Variables and Operators, Controlling Program Flow,Working with Arrays, Using Functions and Classes

UNIT –IV: [11 Periods]

SERVLETS : Overview, Servlet Implementaion, Servlet Configaration, Servlet Lifecycle, Servlet request, Servlet response, Session Tracking, Cookies.

AJAX-ENABLED RICH INTERNET APPLICATIONS : Introduction, Traditional Web Applications vs Ajax Application, XML Http Request Object, Creating AjaX Application.

UNIT –V: [9 Periods]

JSP: JSP Directives, Scripting Elements, Standard Actions, Implicit Objects, Scope.
SEMANTIC WEB: Introduction, A Layered Approach, RDF, OWL**.**

TEXT BOOKS:

1. Harvey M. Deitel and Paul J. Deitel, **"**Internet & World Wide Web How to Program**",** 4/e**,** Pearson Education.
2. Antoniou Grigoris , Groth Paul, Harmelen Frank Van, Hoekstra Rinke, "A Semantic Web Primer" , 3 ed , PHI publications.

REFERENCES:

1. Vikram Vaswani, "PHP: A Beginner's Guide", McGraw-Hill.
2. Subrahmanyam Allamraju et.al, "Professional Java Server Programming", APress.
3. Jim Keogh, "The complete Reference J2EE", Tata McGraw Hill.
4. Tom NerinoDoli smith, **"**JavaScript & AJAX for the web**",** Pearson Education, 2007.
5. Joshua Elchorn, **"**Understanding AJAX**",** Prentice Hall 2006.
6. Karin K Brietman, Marco Antonio Casanova, Walter Truszkowski, "Semantic Web – Concepts", Technologies and Applications, Springer 2007.

CT 574 – Advanced Software Engineering

Lecture : 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 4

Course Learning Objectives: At the end of the Course Students will understand

1. Cover concepts of process models and design techniques.
2. Learn the verification, validation and estimation factors required for software development.
3. Know the advanced topics and tools required for software engineering.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Use Process Models and different Modeling Methods.
2. Apply the concepts of Good Program Design and Models used in various development platforms.
3. Apply verification and validation and software software project management.
4. Use different cost estimation factors required for software development.
5. Advanced Topics and tools required for software engineering.

UNIT-I: [9 Periods]

INTRODUCTION: Notion of Software as a Product – characteristics of a good Software Product. Engineering aspects of Software production – necessity of automation. Job responsibilities of Programmers and Software Engineers as Software developers.

PROCESS MODELS AND PROGRAM DESIGN TECHNIQUES: Software Development Process Models – Code & Fix model, Waterfall model, Incremental model, Rapid Prototyping model, Spiral (Evolutionary) model.

UNIT – II: [9 Periods]

GOOD PROGRAM DESIGN TECHNIQUES: Structured Programming, Coupling and Cohesion, Abstraction and Information Hiding, Automated Programming, Defensive Programming, Redundant Programming, Aesthetics.

Software Modeling Tools –Data flow Diagrams, UML and XML. Jackson System Development.

UNIT – III: [9 Periods]

VERIFICATION AND VALIDATION: Testing of Software Products – Black-Box Testing and White-Box Testing, Static Analysis, Symbolic Execution and Control Flow Graphs –Cyclomatic Complexity. Introduction to testing of Real-time Software Systems.

SOFTWARE PROJECT MANAGEMENT: Management Functions and Processes, Project Planning and Control, Organization and Intra-team Communication, Risk Management.

UNIT – IV: **[9 Periods]**

SOFTWARE COST ESTIMATION: Underlying factors of critical concern. Metrics for estimating costs of software products – Function Points. Techniques for software cost estimation –Expert judgment, Delphi cost estimation, Work break-down structure and Process break down structure, COCOMO and COCOMO-II.

UNIT –V: **[9 Periods]**

ADVANCED TOPICS: Formal Methods in Software Engineering – Z notation, Hoare‟snotation. Formalization of Functional Specifications – SPEC. Support environment forDevelopment of Software Products. Representative Tools for Editors, Linkers, Interpreters,Code Generators, Debuggers.

TOOLS FOR DECISION SUPPORT AND SYNTHESIS: Configuration control and Engineering Databases, Project Management.

Text Books:

1. Fundamentals of Software Engineering – Carlo Ghezziet, Mehdi Jazayeri, Dino Mndrioli
2. Software Engineering – Design, Reliability Management – Pressman.

Reference Books:

1. Web Engineering, The Discipline of Systematic Development of Web Applications, edited by GertiKappel, Birgit Proll, Siegfried Reich, Werner Rretschitzegger, John Wiley & Sons, Ltd.
2. Software Engineering, Theory and Practice, Shari Lawrence Pfleeger, 2nd edition, Pearson Education.
3. Software Engineering, Ian Sommerville, 9th edition, Always Learning, Pearson Education.
4. Fundamentals of Software Engineering, 4th edition, Rajib Mall, PHI.
5. Software Engineering with Abstraction, Berzins and Luqi

CT 575 – Artificial Intelligence

Lecture : 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

Course Learning Objectives: At the end of the Course Students will understand

1. Study the concepts of Artificial Intelligence.
2. Learn the methods of solving problems using Artificial Intelligence.
3. Introduce the concepts of Expert Systems and machine learning.

Course Learning Outcomes: At the end of the course, the student should be able to:

1. Identify problems that are amenable to solution by AI methods.
2. Identify appropriate AI methods to solve a given problem.
3. Formalize a given problem in the language/framework of different AI methods.
4. Implement basic AI algorithms.
5. Design and carry out an empirical evaluation of different algorithms on problem formalization, and state the conclusions that the evaluation supports.

UNIT I: **[9 Periods]**

INTRODUCTION TO Al AND PRODUCTION SYSTEMS: Introduction to AI-Problem formulation, Problem. Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics -Specialized production system- Problem solving methods - Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction - Related algorithms, Measure of performance and analysis of search algorithms.

UNIT II: **[9 Periods]**

REPRESENTATION OF KNOWLEDGE: Game Playing - Knowledge representation, Knowledge Representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.

UNIT III: **[9 Periods]**

KNOWLEDGE INFERENCE: Knowledge representation -Production based system, Frame based system. Inference - Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning – Certainty factors, Bayesian Theory-Bayesian Network-Dempster - Shafer theory.

UNIT IV: **[9 Periods]**

PLANNING AND MACHINE LEARNING: Basic plan generation systems - Strips -Advanced plan generation systems – K strips -Strategic explanations -Why, Why not and how explanations. Learning- Machine learning, adaptive Learning.

UNIT V: **[9 Periods]**

EXPERT SYSTEMS: Expert systems - Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems - MYCIN, DART, XOON, Expert systems shells.

Text Books:

1. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", McGraw Hill- 2008. (Unit-1,2,4,5).
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007. (Unit-III)

References:

1. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.
2. Stuart Russel and Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education, 2007.
3. Deepak Khemani "Artificial Intelligence", Tata McGraw Hill Education 2013.
4. http://nptel.ac.in/

CT 576 – Digital Image Processing

Lecture : 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

Course Learning Objectives: At the end of the Course Students will understand

1. Basic theory and algorithms those are widely used in digital image processing.
2. Basic approached to digital image processing.
3. Concepts of color image processing, shape representation and description.

Course Learning Outcomes: At the end of the course, the student should be able to:

1. Familiarize with overview of image processing systems, Image formation and perception, Continuous and digital image representation.
2. Familiarize with image enhancement in spatial and frequency domain filtering.
3. Familiarize with Image compression and image segmentation.
4. Familiarize with the mathematical morphology for processing an image and shape representation methods.
5. Familiarize with color image processing and object recognition.

UNIT – I: **[10 Periods]**

Introduction: Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System.

Digital Image Fundamentals: Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some basic Relationships between Pixels.

UNIT - II : **[18 Periods]**

Image Enhancement in the Spatial Domain: Some Basic Gray Level Transformation, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing spatial Filters, Sharpening spatial Filters.

Image Enhancement in the Frequency Domain: Introduction to the Fourier Transform and the Frequency Domain, Smoothing frequency domain Filters, Sharpening frequency-domain Filters, Holomorphic Filtering, Implementation.

UNIT – III: **[20 Periods]**

Image Compression: Image Compression Models, Error-free Compression, Lossy Compression, Image Compression Standards.

Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation.

UNIT – IV: **[13 Periods]**

Morphological Image Processing: Dilation and Erosion, The Hit-or-Miss Transformation, Some basic Morphological Algorithms, Extension to Gray-Scale Images.

Representation and Description: Representation, Boundary Descriptors, Regional Descriptors, Use of principal components for Description.

UNIT-V: **[10 Periods]**

Color Image Processing: Color fundamentals, color models, Pseudo color image processing, Basics of color image processing, color image smoothening, color image sharpening, Noise in color images.

Object Recognition: Patterns and Patterns classes, Recognition based on Decision-Theoretic Models, Matching shape Numbers, string Matching, Syntactic Recognition of Strings, and Syntactic Recognition of Trees.

Text Book:

1. Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing' Addison Wesley Pubs (Second Edition).

Reference Books:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle Image Processing. Analysis, and Machine Vision (Second Edition).
2. A.K.Jain, 'Fundamentals of Digital Image Processing' PHI.

CT 577 – Blockchain Technology

Lecture : 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

UNIT – I: **[9 Periods]**

Origins of Blockchain technology: Electronic Systems and Trust, Distributed Vs. Centralized Vs. Decentralized, Bitcoin Predecessors- DigiCash, E-Gold, Hashcash, B-Money, Bit Gold.Bringing BItcoin to Life – Compelling Components, Achieving Consensus.

Unit – II: **[9 Periods]**

Cryptocurrency fundamentals: Public and Private Keys in Cryptocurrency Systems, UTXO Model, Transactions, The Merkel Root, Signing and Validating Transactions, The Coinbase Transaction, Hashes, Security Fundamentals, Mining, Consensus, Stakeholders

Unit – III: **[9 Periods]**

The Evolution of Ethereum: Improving Bitcoin's Limited Functionality – Mastercoin and Smart Contracts, Understanding Omni Layer, Ethereum: Taking Mastercoin to the Next Level,Ether and Gas, Decentralized Autonomous Organizations, Decentralized Applications(Dapps), Deploying and Executing Smart Contracts in Ethereum- The Ethereum VM, Gas and Pricing and Interacting with Code

Unit – IV: **[9 Periods]**

Blockchain Concepts: Ethereum Fundamentals, Decentralized Applications: Tokens, Supplychain, permanent records, Evaluating Blockchain for your application. Ethereum Clients.

Unit – V: **[9 Periods]**

Developing Smart Contract: - Our First Smart Contract: Setup, Our First Test, Making Our Contract Dynamic, Making the Greeter Ownable,

Developing and Interacting with Contracts: Contract Compilation and Deployment, Setting up the UI, Deploying to Ganache, Deploying to Goerliwith Parity, Deploying to Rinkeby with Infura

References:

1. Lorne Lantz & Daniel Carwrey, Mastering Blockchain, Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications.

2. Kevin Solario, David Hooper, Kevin Solorio, Hands–On Smart Contract Development with Solidity and Ethereum: From Fundamentals to Deployment, Oreilly Publications, 6 December 2019.

CT 578 Quantum Computing and Information Theory

Lecture : 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

UNIT – I: **[9 Periods]**

Motivation for studying Quantum Computing, Major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc.), Origin of Quantum Computing, Overview of major concepts in Quantum Computing: Qubits and multi-qubits states, Bra-ket notation, Bloch Sphere representation, Quantum Superposition, Quantum Entanglement.

Unit – II: **[9 Periods]**

Matrix Algebra: basis Vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigen vectors.

Unit – III: **[9 Periods]**

Architecture of a Quantum Computing platform, Details of qbit system of information representation: Block Sphere, Multi-qubits States, Quantum superposition of qubits (valid and invalid superposition),Quantum Entanglement, Useful states from quantum algorithmic perceptive e.g. Bell State, Operation on qubits: Measuring and transforming using gates,

Unit – IV: **[9 Periods]**

Quantum Logic gates and Circuit: Pauli, Hadamard, phase shift, controlledgates, Ising, Deutsch, swap etc, Programming model for a Quantum Computing Program: Steps performed on classical computer, Steps performed on Quantum Computer, Moving data between bits and qubits.

Unit – V: **[9 Periods]**

Basic Techniques Exploited by Quantum Algorithms: Amplitude Amplification, Quantum Fourier Transform, Phase Kick-Back, Quantum Phase Estimation, Quantum Walks, Major, Algorithms: Shor's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch –Jozsa Algorithm, Oss Toolkits For Implementing Quantum Program: Ibm Quantum Experience, Microsoft Q, Rigetti Pyquil (Qpu/Qvm).

References:

1. Quantum Computation and Quantum Information, M A Nielsen and I L Chuang.
2. David McMahon, “Quantum Computing Explained”, Wiley Publications
3. An Introduction to Quantum Computing, P Kaye, R Laflamme and M Mosca.
4. Pittenger A. O., An Introduction to Quantum Computing Algorithms 2000
5. https://www.ibm.com/quantum-computing/quantum-computing-at-ibm/
6. https://azure.microsoft.com/en-us/resources/development-kit/quantum-computing/
7. https://pyquil-docs.rigetti.com/en/stable/qvm.html#the-quantum-virtual-machine-qvm
8. https://ai.googleblog.com/2020/03/announcing-tensorflow-quantum-open.html
9. https://www.cse.iitk.ac.in/users/rmittal/prev_course/s16/course_s16.php

CT 579 Information Security

Lecture : 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

Course Learning Objectives: At the end of the Course Students will understand

1. The SDLC for information security implementation.
2. The issues related to legal, ethical, and professional in information security.
3. The Risk control Security technology architectures and tools.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Know the security system development life cycle
2. Familiar with the legal, ethical, and professional issues in information security.
3. Apply Risk control and management strategies.
4. Familiar with firewalls and firewall architectures.
5. Familiarize with security technologies and tools.

UNIT I: **[9 Periods]**

Introduction to Information Security: The history of Information Security, What is Security?, CNSS Security Model.

Approaches to Information Security Implementation: The system development Life Cycle, The security systems development Life Cycle, Security Professionals and the Organization, Communities of Interest.

UNIT II: **[9 Periods]**

The Need for Security: Business Needs First, Threats, Attacks, and Secure Software Development.

Legal, Ethical, and Professional Issues in Information Security: Relevant U.S. Laws, International Laws and Legal Bodies, Ethics and Information Security, Codes of Ethics and Professional Organizations.

UNIT III: **[9 Periods]**

Risk Management: An Overview of Risk Management, Risk Identification, Risk Assessment.

Risk Control Strategies: Selecting a Risk Control Strategy, Quantitative Versus Qualitative Risk Control Practices, Risk Management Discussion Points, Recommended Risk Control Practices.

UNIT IV: **[9 Periods]**

Security Technology: Introduction**,** Firewalls and VPNs.

Firewall Architectures: Firewall Architectures, Protecting Remote Connections.

UNIT V: **[9 Periods]**

Security Technology: Introduction, Intrusion Detection and Prevention Systems, Honeypots, Honeynets, and Padded Cell Systems.

Other Security Tools: Scanning and Analysis Tool, Biometric Access Tools.

Text Book

1. Michael E. Whitman, Harbert J. Mattord, “Principles of Information Security”, 4th Edition, Course Technology, CENGAGE Learning.

References:

1.Deven N. Shah, “Mark Stamp's Information Security: Principles and Practice (WIND)”, Wiley.
2.David Alexander, Amanda Finch, David Sutton, Andy Taylor, “Information Security Management Principles”, Second Edition, BCS, The Chartered Institute for IT.

CT 580 – CT 580 AR & VR

Lecture : 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

UNIT I: **[9 Periods]**

Introduction to Virtual Reality: Introduction, Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality. Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark 3D Computer Graphics: Introduction, The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory, Simple 3D modelling, Illumination models, Reflection models, Shading algorithms, Radiosity, Hidden Surface Removal, Realism-Stereographic image.

UNIT II: **[9 Periods]**

Interactive Techniques in Virtual Reality: Introduction, From 2D to 3D, 3D space curves, 3D boundary representation Geometrical Transformations: Introduction, Frames of reference, Modeling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems.

UNIT III: **[9 Periods]**

Visual Computation in Virtual Reality: Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object inbetweening, free from deformation, particle system. Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

UNIT III: **[9 Periods]**

Augmented and Mixed Reality: Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality

applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

UNIT IV: **[9 Periods]**

Multiple Models of Input and Output Interface in Virtual Reality: Human factors: Introduction, the eye, the ear, the somatic senses. VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. VR Software: Introduction, Modeling virtual world, Physical simulation, VR toolkits, Introduction to VRML, Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output -- Visual /Auditory / Haptic Devices.

UNIT V: **[9 Periods]**

Application of VR in Digital Entertainment: VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR.

Text Books:

1. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.
2. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
3. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.
4. John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2007.
5. Anand R., “Augmented and Virtual Reality”, Khanna Publishing House, Delhi.
6. Adams, “Visualizations of Virtual Reality”, Tata McGraw Hill, 2000.
7. Grigore C. Burdea, Philippe Coiffet , “Virtual Reality Technology”, Wiley Inter Science, 2nd Edition, 2006.

CT 581 – Wireless Networks

Lecture : 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

Course Learning Objectives: At the end of the Course Students will understand

1. To study about Wireless networks, protocol stack and standards.
2. To study about fundamentals of 3G Services, its protocols and applications.
3. To study about evolution of 4G Networks, its architecture and applications.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Conversant with the latest 3G/4G and WiMAX networks and its architecture.
2. Design and Implement routing mechanism in mobile ad-hoc network.
3. An ability to understand the fundamentals of Transport Layer Protocols.
4. Design and implement wireless network environment for any application using latest wireless protocols and standards.
5. Implement different type of applications for smart phones and mobile devices with latest network strategies.

UNITI: Wireless LAN [9 Periods]

Introduction-WLAN technologies: Infrared, UHF narrowband, spread spectrum -IEEE802.11: System architecture, protocol architecture, physical layer, MAC layer, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, Radio Layer, Baseband layer, Link manager Protocol, security – IEEE802.16-WIMAX: Physical layer, MAC, Spectrum allocation for WIMAX.

UNIT II: Mobile Network Layer [9 Periods]

Introduction – Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol – mobile ad-hoc network: Routing, Destination Sequence distance vector, Dynamic source routing

UNIT III: Mobile Transport Layer [9 Periods]

TCP enhancements for wireless protocols – Traditional TCP: Congestion control, fast retransmit/fast recovery, Implications of mobility – Classical TCP improvements: Indirect TCP, Snooping TCP, Mobile TCP, Time out freezing, Selective retransmission, Transaction oriented TCP – TCP over 3G wireless networks.

UNIT IV: Wireless Wide Area Network [9 Periods]

Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3G-MSC, 3G-SGSN, 3G-GGSN, SMS-GMSC/SMS-IWMSC, Firewall, DNS/DHCP-High speed Downlink packet access (HSDPA)- LTE network architecture and protocol.

UNIT V: 4G Networks **[9 Periods]**

Introduction – 4G vision – 4G features and challenges – Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, OFDM-MIMO systems, Adaptive Modulation and coding with time slot scheduler, Cognitive Radio.

Text Books:

1. Jochen Schiller, ”Mobile Communications”, Second Edition, Pearson Education 2012.(Unit I,II,III)
2. Vijay Garg , “Wireless Communications and networking”, First Edition, Elsevier 2007.(Unit IV,V)

References:

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, “3G Evolution HSPA and LTE for Mobile Broadband”, Second Edition, Academic Press, 2008.
2. Anurag Kumar, D.Manjunath, Joy kuri, “Wireless Networking”, First Edition, Elsevier 2011.
3. Simon Haykin , Michael Moher, David Koilpillai, “Modern Wireless Communications”,

CT 582 – Deep Learning

Lecture : 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

UNIT – I: **[9 Periods]**

A Review of Machine Learning: The Learning Machines – What is Deep Learning, How does machine learning work – Regression, under fitting and overfitting, optimization, convex optimization, gradient descent, stochastic gradient descent. Evaluating Models
[9 Periods]

Unit – II: **[9 Periods]**

Fundamentals of Neural Networks and Deep Learning: Neural Networks, Training Neural Networks, Activation Functions, Loss Functions and Hyper parameters. Fundamentals of Deep Networks: Defining Deep Learning, Common Architectural Principles of Deep Networks-Parameters, Layers, Activation Functions, Loss Functions, Optimization Algorithms, Hyper parameters

Unit – III: **[9 Periods]**

Fundamentals of Deep Networks: Defining Deep Learning, Common Architectural Principles of Deep Networks, Building Blocks of Deep Networks-RBMs, Autoencoders, Major Architectures of Deep of

Unit – IV: **[9 Periods]**

Convolutional Neural Networks: CNN Architecture Overview, Pooling Layers, Fully Connected Layers, Other Applications of CNN

Unit – V: **[9 Periods]**

Recurrent Neural Networks: Modeling the Time Dimension, 3D Volumetric Input, Why Not Markov Models, General Recurrent Neural Network Architecture, LSTM Networks, Recursive Neural Networks.

References:
1. Adam Gibson and Josh Patterson, Deep Learning: A Practitioner's Approach Book
2. Charu C. Aggarwal, Neural Networks and Deep Learning
3. Aaron C. Courville, Ian Goodfellow, and Yoshua Bengio, Deep Learning
4. , Michael Nielsen, Neural Networks and Deep Learning, The original online book can be found at http://neuralnetworksanddeeplearning.com.

CT 583 – Big Data Analytics

Lecture: 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

Course Learning Objectives: At the end of the Course Students will understand

1. Data Mining and Massive Data Management.
2. Mining of Massive Datasets using different Techniques.
3. Internet Recommendations and Social Network Analysis.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Know data mining in distributed file management environment.
2. Understand the similarity principle when it is applied on massive datasets.
3. Contrast the key technical issued of Data Streams.
4. Recognize the importance link analysis and frequent item sets.
5. Know the applications like recommendation systems and social network graphs.

UNIT – I **[9 Periods]**

Data Mining: What is Data Mining?, Statistical Limits on Data Mining. Map Reduce and the New Software Stack, Distributed File Systems, Map Reduce, Algorithms Using Map Reduce, Extensions to Map Reduce, The Communication Cost Model.

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UNIT – II **[9 Periods]**

Finding Similar Items: Applications of Near-Neighbor Search, Shingling of Documents, Similarity-Preserving Summaries of Sets, Finding Similar Items, Locality-Sensitive Hashing for Documents, Distance Measures, the Theory of Locality-Sensitive Functions.

UNIT – III **[9 Periods]**

Mining Data Streams: The Stream Data Model, Sampling Data in a Stream, Filtering Streams. Mining Counting Distinct Elements in a Stream, Estimating Moments, Counting Ones in a Window.

UNIT—IV **[10 Periods]**

Mining Link Analysis: Page Rank, Efficient Computation of Page Rank, Topic-Sensitive Page Rank, Link Spam.

Frequent Item Sets: The Market-Basket Model, Market Baskets and the A-Priori Algorithm, Handling Larger Data Sets in Main Memory.

UNIT – V **[10 Periods]**

Recommendation Systems: A model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering, Dimensionality Reduction.

Social-Network Graphs: Social Networks as Graphs, Clustering of Social-Network Graphs, Direct Discovery of Communities, Partitioning of Graphs.

Text Book:

1. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, "**Mining of Massive Datasets**", 2nd Edition, 2014.

References:

1. Paul Zikopoulos et al, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGraw Hill Professional, USA, 2011.
2. Jimmy Lin and Chris Dyer, “Data Intensive Text Processing using MapReduce”, Morgan and Claypool Publishers, USA, 2010.
3. Tom White, “Hadoop: The Definitive Guide”, O`Reilly Publishers, USA, 2012.
4. EelcoPlugge, Tim Hawkins and Peter Membrey, “The Definitive Guide to MongoDB: The NoSQL Database for Cloud andDesktop Computing”, Apress, USA, 2010.
5. Norman Matloff, “The Art of R Programming: A Tour of Statistical Software Design”, No Starch Press, USA, 2011.

CT 584 – Cloud Computing

Lecture: 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

Course Learning Objectives: At the end of the Course Students will understand

1. Distributed concepts and Virtualization.
2. And expose to the world of Cloud Programming and Cloud Services.
3. Cloud Security and Cloud Applications.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Use Cloud Computing environment Data Models and understand the Database Context.
2. Apply the hardware and software concepts and architecture of cloud computing.
3. Contrast the key technical and commercial issues concerning cloud computing versus traditional software models.
4. Recognize the importance Cloud Security.
5. Know the application development in Cloud Environment.

UNIT – I: **[9 Periods]**

DISTRIBUTED SYSTEM MODELS AND ENABLING TECHNOLOGIES: Scalable Computing over the Internet, Technologies for Network-Based Systems, System Models for Distributed and Cloud Computing, Software Environments for Distributed Systems and Clouds.

UNIT – II **[9 Periods]**

VIRTUAL MACHINES AND VIRTUALIZATION OF CLUSTERS AND DATA CENTERS: Implementation levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Virtualization of CPU, Memory and I/O devices.

UNIT III: **[9 Periods]**

CLOUD PROGRAMMING AND SOFTWARE ENVIRONMENTS: Features of Cloud and Grid Platforms, Programming on Amazon AWS and Microsoft Azure, Emerging Cloud Software Environments.

UNIT IV: **[9 Periods]**

PEER-TO-PEER COMPUTING AND OVERLAY NETWORKS: Peer-to-Peer Computing Systems, P2P Overlay Networks and Properties, Routing, Proximity, and Fault Tolerance, Trust, Reputation and Security Management.

UNIT V: **[9 Periods]**

UBIQUITOUS CLOUDS AND THE INTERNET OF THINGS: Cloud Trends in Supporting Ubiquitous Computing, Enabling Technologies for the IoT, Innovative Applications of the IoT, Online Social and Professional Networking.

Text Books:

1. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, "Distributed and Cloud Computing: From Parallel Processing to the Internet of Things", Morgan Kaufmann, 2012.

References:

1. Danielle Ruest and Nelson Ruest, "Virtualization: A Beginners Guide", Tata McGraw Hill, New Delhi, 2009.
2. Chris Wolf and Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", Apress, 2005.
3. Anthony T Velte, Toby J Velte and Robert Elsenpeter, "Cloud Computing – A Practical Approach", Tata McGraw Hill, NewDelhi, 2010.
4. Ronald L Krutz and Russell Dean Vines, "Cloud Security- A Comprehensive Guide to Secure Cloud Computing", Wiley India,New Delhi, 2010.

5 . James Murty, "Programming Amazon Web Services: S3 EC2 SQS FPS and Simpledb", Shroff Publishers, Mumbai, 2008.

CT 585 – Internet of Things

Lecture: 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

Course Learning Objectives: At the end of the Course Students will understand

1. Basic issues, policy and challenges in the Internet.
2. Components and the protocols in Internet and managing the resources in the Internet
3. Deploying the resources into business and Cloud and Internet environment.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Identify and design the components of IOT.
2. Develop Programs for the sensors and controllers.
3. Manage resources in IoT.
4. Model the Internet of things to business.
5. Develop applications for the web of things.

UNIT I : INTRODUCTION [9 Periods]

Definition – phases – Foundations – Policy– Challenges and Issues - identification - security – privacy. Components in internet of things: Control Units – Sensors – Communication modules – Power Sources – Communication Technologies – RFID – Bluetooth – Zigbee – Wifi – Rflinks – Mobile Internet –Wired Communication.

UNIT II :PROGRAMMING THE MICROCONTROLLER FOR IOT [9 Periods]

Basics of Sensors and actuators – examples and working principles of sensors and actuators – Cloud computing and IOT – Arduino/Equivalent Microcontroller platform – Setting up the board Programming for IOT – Reading from Sensors.

Communication: Connecting microcontroller with mobile devices – communication through Bluetooth and USB – connection with the internet using wifi / Ethernet.

UNIT III : RESOURCE MANAGEMENT IN THE INTERNET OF THINGS [9 Periods]

Clustering - Software Agents - Data Synchronization - Clustering Principles in an Internet of Things Architecture - The Role of Context - Design Guidelines -Software Agents for Object - Data Synchronization- Types of Network Architectures - Fundamental Concepts of Agility and Autonomy- Enabling Autonomy and Agility by the Internet of Things-Technical Requirements for Satisfying the New Demands in Production - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things- Agents for the Behaviour of Objects

UNIT IV: BUSINESS MODELS FOR THE INTERNET OF THINGS [9 Periods]

The Meaning of DiY in the Network Society- Sensor-actuator Technologies and Middleware as a Basis for a DiY Service Creation Framework - Device Integration - Middleware Technologies Needed for a DiY Internet of Things Semantic Interoperability as a Requirement for DiY Creation -Ontology- Value Creation in the Internet of Things-Application of Ontology Engineering in the Internet of Things-Semantic Web-Ontology - The Internet of Things in Context of EURIDICE Business Impact

UNIT V: FROM THE INTERNET OF THINGS TO THE WEB OF THINGS: [9 Periods]

Resource-oriented Architecture and Best Practices- Designing REST ful Smart Things – Webenabling Constrained Devices - The Future Web of Things - Set up cloud environment – send data from microcontroller to cloud – Case studies – Open Source e-Health sensor platform – Be Close Elderly monitoring – Other recent projects.

TEXT BOOKS:

1. CharalamposDoukas, Building Internet of Things with the Arduino, Create space, April 2002.
2. Dieter Uckelmann et.al, “Architecting the Internet of Things”, Springer, 2011.

REFERENCES:

1.Luigi Atzor et.al, “The Internet of Things: A survey, “, Journal on Networks, Elsevier Publications, October, 2010
2.http://postscapes.com/
3.http://www.theinternetofthings.eu/what-is-the-internet-of-things

CT 586 – Mobile Computing

Lecture: 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

Course Learning Objectives: At the end of the Course Students will understand

1. basic concepts of mobile communication and mobile devices.
2. architectures for mobile computing and protocols used for mobile communication/computing.
3. mobile device databases and operating systems.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Know the mobile communication with different mobile devices.
2. Know the architectures for mobile computing.
3. Identify the protocols of the different layers in mobile communication.
4. Familiarize with mobile TCP.
5. Identify the operating systems and databases suitable for the mobile devices.

UNIT I: **[9 Periods]**

MOBILE COMMUNICATION: An Overview: Mobile Communication, Mobile Computing, Mobile Computing Architecture, Mobile Devices, Mobile System Networks, Data Dissemination

MOBILE DEVICES AND SYSTEMS: Mobile Phones, Digital Music Players, Handled Pocket Computers, Handled Devices: Operating Systems, Smart Systems.

UNIT II: **[9 Periods]**

GSM AND SIMILAR ARCHITECTURES: GSM-Services and System Architecture, Radio Interfaces, Protocols, Localization, Calling, Handover, New Data Services, General Packet Radio Services, High Speed Circuit Switched Data.

WIRELESS MEDIUM ACCESS CONTROL AND CDMA-BASED COMMUNICATION: Medium Access Control, Introduction to CDMA-based Systems, Spread Spectrum in CDMA Systems, Coding Methods in CDMA.

UNIT III: **[9 Periods]**

MOBILE IP NETWORK LAYER: IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, RegistrationTunneling and Encapsulation, Route Optimization, Dynamic Host Configuration Protocol.

MOBILE TRANSPORT LAYER: Conventional TCP/IP Transport Layer Protocols, Indirect TCP, Snooping TCP.

UNIT IV: **[9 Periods]**

MOBILE TCP: Other Methods of TCP-Layer Transmission for Mobile Networks, TCP Over 2.5G/3G Mobile Networks.

UNIT V: **[9 Periods]**

DATABASES: Database Hoarding Techniques, Data Caching, Client-Server Computing and Adaption, Transaction Models, Query Processing, Data Recovery Process.

MOBILE OPERATING SYSTEMS: Operating Systems, PalmOs, Windows CE, Symbian Os, Linux for Mobile Devices.

TEXT BOOK:

1. Raj Kamal, "Mobile Computing", OXFORD University Press.

REFERENCE BOOKS:

1. Prasant Kunar Pattnaik, Rajib Mall, " Fundamentals of Mobile Computing", PHI Learning Pvt. Ltd.
2. UweHansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, " Principles of Mobile Computing", Springer.

CT 587 – Agile Software Development

Lecture: 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

Course Learning Objectives: At the end of the Course Students will understand

1. the fundamental principles and practices associated with each of the agile development methods.
2. how agile methods scale to large and distributed projects.
3. in-depth explorations into aspects of agile development.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Familiarize with various agile development methods called Scrum, XP, FDD, DSDM methods.
2. Familiarize with inception phase of agile development, and scope and vision of the project.
3. Familiarize with technical strategy and release planning with agile development.
4. Familiarize with construction and transition phases of agile development.
5. Apply Scrum and Sprint agile methodologies in system development.

UNIT – I: **[9 Periods]**

Introduction to Agile and Lean: Toward a Disciplined Agile Manifesto, Disciplined Agile Values, Disciplined Agile Principles, Lean Principles, Reality over Rhetoric.

Foundations of Disciplined Agile Delivery: Scrum, Extreme Programming (XP), Agile Modeling (AM), Agile Data, Lean Software Development, Open Unified Process (OpenUP).

Roles, Rights, and Responsibilities: The Rights of Everyone, The Responsibilities of Everyone, The DAD Roles.

UNIT – II: **[9 Periods]**

The Inception Phase: How the Inception Phase Works, Aligning with the Rest of the Enterprise, Securing Funding, Other Inception Activities, When Do You Need an Inception Phase?, Inception Phase Patterns, Inception Phase Anti-Patterns.

Identifying a Project Vision: What's in a Vision?, How Do You Create a Vision?, Capturing Your Project Vision, Bringing Stakeholders to Agreement Around the Vision.

Identifying the Initial Scope: Choosing the Appropriate Level of Initial Detail, Choosing the Right Types of Models, Choosing a Modeling Strategy, Choosing a Work Item Management Strategy.

UNIT – III: **[9 Periods]**

Identifying an Initial Technical Strategy: Choosing the Right Level of Detail, Choosing the Right Types of Models, Choosing a Modeling Strategy, Architecture throughout the Lifecycle.

Initial Release Planning: Who Does the Planning?, Choosing the Right Scope for the Plan, Choosing a General Planning Strategy, Choosing Cadences, Formulating an Initial Schedule, Estimating the Cost and Value, Identifying Risks.

UNIT – IV **[9 Periods]**

The Construction Phase: How the Construction Phase Works, The Typical Rhythm of Construction Iterations, The Risk-Value Lifecycle, When Are You Ready to Deploy? , Construction Patterns, Construction Anti-Patterns.

Initiating a Construction Iteration: Why Agile Planning Is Different, Iteration Planning, Visualizing Your Plan, Look-Ahead Planning and Modeling.

The Transition Phase: How the Transition Phase Works, Planning the Transition Phase, Ensuring Your Production Readiness, Preparing Your Stakeholders for the Release, Deploying the Solution, Transition Phase Patterns, Transition Phase Anti-Patterns.

UNIT – V **[9 Periods]**

Scrum Framework: Scrum Roles, Scrum Activities and Artifacts, Sprints, Daily Scrum.

Sprints: Timeboxed, Short Duration, Consistent Duration, No Goal-Altering Changes, Definition of Done.

Text Books:

1. Scott W. Ambler, Mark Lines, Disciplined Agile Delivery: A Practitioner's Guide to Agile Software Delivery in the Enterprise, IBM Press, 2012 .(UNIT – I to UNIT – IV)
2. K.S. Rubin, Essential Scrum: A Practical Guide to the Most Popular Agile Process, Addison-Wesley, 2012.(UNIT V)

Reference Books:

1. K. Beck, Test Driven Development: By Example, Addison-Wesley, 2002.
2. K. Beck, C. Andres, Extreme Programming Explained: Embrace Change, 2nd Edition, Addison-Wesley, 2004.
3. M. Cohn, Succeeding with Agile: Software Development Using Scrum, Addison-Wesley, 2010.
4. M. Fowler, Catalog of Refactorings, Published online at: http://refactoring.com/catalog/, December 2013 (last visited on: 3 August 2014).
5. K. Schwaber, J. Sutherland, The Scrum Guide, Published online at: https://www.scrum.org/scrum-guide, July 2013 (last visited on: 3 August 2014).

CT 588 – Data Engineering

Lecture: 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

Course Learning Objectives: At the end of the Course Students will understand

1. Basics of data warehousing, kinds of data in real world, data preprocessing, and Data mining.
2. Association rule mining, and classification techniques.
3. Clustering and applications of data mining on complex data objects.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Apply fundamental concepts for the construction of Data Warehouse.
2. Familiarize with Data Mining concepts.
3. Extract association rules from transactional databases.
4. Demonstrate different classification techniques.
5. Implement various clustering techniques and and data mining concepts on complex data objects.

UNIT- I: **[12 Periods]**

Data Warehousing and Online Analytical Processing: Data Warehouse: Basic Concepts- Data Warehouse Modeling: Data Cube and OLAP-Data Warehouse Design and Usage- Data Warehouse Implementation.

Data Preprocessing: An overview of Data Preprocessing- Data cleaning- Data Integration- Data Reduction- Data Transformation and Data Discretization.

UNIT- II: **[12 Periods]**

Getting to know Your Data: Data Objects and Attribute Types- Basic Statistical Descriptions of Data- Measuring Data Similarity and Dissimilarity.

Introduction: Why Data Mining- What is Data Mining?-What Kinds of Data can be mined?- What Kinds of Patterns can be mined?- Which Technologies are used?- Major Issues in Data Mining.

UNIT-III: **[15 Periods]**

Mining Frequent Patterns, Associations, and Correlations: Basic Concepts- Frequent Item set Mining Methods: Apriori Algorithm, Generating Association Rules, Improving the efficiency of Apriori, FP Growth Approach for Mining Frequent Item Sets, Mining Frequent Item Sets using Vertical Data Format Method.

Advanced Pattern Mining: Mining Multilevel Associations- Mining Multidimensional Associations- Mining Quantitative Association Rules-Mining Rare Patterns and Negative Patterns- Constrained based Frequent Pattern Mining.

UNIT- IV : **[15 Periods]**

Classification: Basic Concepts- Decision tree induction- Bayes Classification Methods- Rule-Based Classification- Model Evaluation and Selection- Techniques to Improve Classification Accuracy.

Advanced Methods in Classification: Bayesian Belief Networks-Classification by Backpropagation-Classification by Support Vector Machines-Lazy Learners-Other Classification Methods.

UNIT- V: **[12 Periods]**

Cluster Analysis: Introduction to cluster analysis- partitioning methods- Hierarchical methods- Density-Based Methods:DBSCAN-Grid-based Method:STING, Outliers and Outlier Analysis- Outlier Detection Methods.

Data Mining Trends: Mining Sequence Data- Mining Graphs and Networks- Mining Other Kinds of Data- Data Mining Applications.

Text Book:

1. Data Mining Concepts & Techniques, Jiawei Han, MichelineKamber, and Jian Pei, 3/e, Morgan Kaufmann Publishers.

Reference Books:

1. Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, Addison Wesley.
2. Data Warehouse Toolkit, Ralph Kimball, John Wiley Publishers.

CT 589 – Evolutionary Computation

Lecture: 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

Course Learning Objectives: At the end of the Course Students will understand

1. Basics of Genetic Algorithm and Evolutionary Algorithms, Operations in Evolutionary Computation.
2. Different Evolutionary Algorithms.
3. Evolutionary Algorithms with Multi Objective Functions.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Identify Algorithms suitable for solving certain Evolutionary computation problems
2. Know the usage of operators in Evolutionary Computation
3. Apply Evolutionary Computing Techniques for optimization, learning and design
4. Familiar with various Evolutionary Computation Techniques
5. Know the Evolutionary Algorithms with Multi Objective Functions.

UNIT I: **[9 Periods]**

INTRODUCTION: History, Inspiration from biology: Darwinian evolution - Genetics, Need of evolutionary computing.

EVOLUTIONARY ALGORITHM: Components of Evolutionary Algorithms (EA), Working principle of EA, Applications: N-Queens problem - Knapsack problem, Introduction to different branches of evolutionary computation: Genetic algorithm – Evolutionary programming - Evolutionary strategies - Genetic programming.

UNIT II: **[9 Periods]**

VARIANTS OF EVOLUTIONARY COMPUTATION: EA vs traditional methods, Representation, Mutation, Recombination, Population models, Parent selection, Survivor selection.

UNIT III: **[9 Periods]**

EVOLUTIONARY COMBINATORIAL OPTIMIZATION: Local search: Simulated annealing - Tabu search, Hybrid algorithm: Lamarckian evolution - Memetic algorithms, Application: Knapsack problem - Minimum spanning tree problem - Travelling Salesman Problem (TSP).

UNIT IV: **[9 Periods]**

OTHER EVOLUTIONARY TECHNIQUES: Ant Colony Optimization (ACO): Real to artificial ants - ACO algorithm - Convergence proofs, Particle Swarm Optimization (PSO): Principles of bird flocking and fish schooling - PSO algorithm - Variants of PSO, Application: TSP.

UNIT V: **[9 Periods]**

MULTIOBJECTIVE EVOLUTIONARY OPTIMIZATION: Introduction, Pareto optimality, Multi-Objective evolutionary algorithms.

TEXT BOOK:

1. Eiben A E and Smith J E, “Introduction to Evolutionary Computing”, Springer, New York, 2008.

REFERENCES:

1. Frank Neumann and Carsten Witt, “Bio-inspired Computation in Combinatorial Optimization”, Springer, New York, 2010.
2. Marco Dorigo and Thomas Stutzle, “Ant Colony Optimization”, Prentice Hall, New Delhi, 2005.
3. Jun Sun, Choi-Hong Lai and Xiao-Jun Wu, “Particle Swarm Optimisation: Classical and Quantum Perspectives”, Taylor and Francis, USA, 2012.
4. Carlos A CoelloCoello, Gary B Lamont and David A Van Veldhuizen, “Evolutionary Algorithms for Solving Multi-Objective Problems”, Springer, New York, 2007.
5. David B Fogel, “Evolutionary Computation”, IEEE Press, New York, 2000.

CT 590 – Parallel Algorithms

Lecture: 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

Course Learning Objectives: At the end of the Course Students will understand

1. Parallel and distributed algorithms development techniques for shared memory and message passing models.
2. Various models of parallel algorithms.
3. The complexity and correctness models for parallel algorithms.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Know massive parallelism on large-scale and model parallel programs for Selection and merging.
2. Analyze and model parallel programs sorting and searching.
3. Analyze and model parallel programs for permutation, Combination and Matrix.
4. Analyze and model parallel programs for Graph algorithms and applications.
5. Analyze and model parallel programs for Computing Prefix Sums and Applications.

UNIT – I: **[12 Periods]**

Introduction to Parallel Algorithms: Models of Computation – Analyzing Algorithms, Selection-The Problem and a lower Bound, A Sequential algorithm, Desirable Properties of Parallel algorithm, An algorithm for parallel Selection.

Merging: A Network for Merging, Merging on the CREW and EREW Models – A better Algorithm for the EREW model.

UNIT – II: **[12 Periods]**

Sorting: A network for Sorting, Sorting on a Linear Array, Sorting on CRCW, CREW, EREW Models.

Searching: Searching a Sorted Sequence – Searching a Random Sequence, Searching on a tree, searching on Mesh.

UNIT – III: **[12 Periods]**

Generating Permutations and Combinations: Sequential Algorithms, generating permutations in Parallel, generating combinations in Parallel.

Matrix Operations: Transpositions, Matrix by Matrix Multiplications, Matrix by Vector multiplication.

UNIT – IV: **[12 Periods]**

Connectivity Matrix: Computing the Connectivity Matrix, Finding Connected Components.

All Pairs Shortest Paths: Computing Minimum Spanning Trees.

UNIT – V: **[12 Periods]**

Computing Prefix Sums: A Specialized Network, Using the unshuffle Connection, Prefix Sums on a Tree, Prefix Sums on a Mesh.

Applications: Job Sequencing with Deadlines, Knapsack Problem, Mesh Solutions.

Text Books:

1. Selim G. Akl, "The Design and Analysis of Parallel Algorithms", Prentice Hall, New Jersey, 1989

Reference Books:

1. Michael J. Quinn, "Parallel Computing: Theory & Practice", Tata McGraw Hill Edition, 2003.
2. Justin R. Smith, "the Design and Analysis of Parallel Algorithms", Oxford University Press, USA, 1993.
3. Joseph JaJa, "Introduction to Parallel Algorithms", Addison Wesley, 1992.

CT 591 – Fuzzy Set Theory and Applications

Lecture: 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

Course Learning Objectives: At the end of the Course Students will understand

1. the basics of the fuzzy sets and definitions, operations on fuzzy sets and measures of fuzziness
2. the extension principles and relations on fuzzy sets
3. the applications of the fuzzy set theory.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. know the basic definitions and basic operations of the fuzzy sets
2. identify deferent types of fuzzy sets, operations and measures of fuzziness
3. familiarize with the principles of the fuzzy sets and relations and fuzzy graphs
4. acquainted with functions on fuzzy sets and modeling of uncertainty
5. familiar with applications of fuzzy sets and expert systems

UNIT-I: **[12 Periods]**

Introduction to Fuzzy Sets: Crispness, Vagueness, Fuzziness, Uncertainty, Fuzzy Set Theory,Fuzzy Mathematics.

Fuzzy Sets-Basic Definitions: Basic Definitions, Basic Set-Theoretic Operations for Fuzzy Sets.

UNIT-II: **[12 Periods]**

Extensions: Types of Fuzzy Sets Further Operations on Fuzzy Sets**,** Algebraic Operations**,** Set-Theoretic Operations**,** Criteria for Selecting Appropriate Aggregation Operators.

Fuzzy Measures and Measures of Fuzziness: Fuzzy Measures, Measures of Fuzziness.

UNIT-III: **[12 Periods]**

The Extension Principle and Applications, The Extension Principle, Operations for Type 2 Fuzzy Sets, Algebraic Operations with Fuzzy Numbers, Special Extended Operations, Extended Operations for LR-Representation of Fuzzy Sets.

Fuzzy Relations and Fuzzy Graphs, Fuzzy Relations on Sets and Fuzzy Sets, Compositions of Fuzzy Relations, Properties of the Min-Max Composition, Fuzzy Graphs, Special Fuzzy Relations.

UNIT-IV: **[12 Periods]**

Fuzzy Analysis, Fuzzy Functions on Fuzzy Sets, Extrema of Fuzzy Functions, Integration of Fuzzy Functions, Integration of a Fuzzy Function over a Crisp Interval ,Integration of a (Crisp) Real-Valued Function over a Fuzzy Interval, Fuzzy Differentiation.

Uncertainty Modelling: Application-oriented Modelling of Uncertainty, Causes of Uncertainty, Type of Available Information, Uncertainty Methods, Uncertainty Theories as Transformers of Information, Matching Uncertainty Theory and Uncertain Phenomena.

UNIT-V: **[12 Periods]**

Fuzzy Logic and Approximate Reasoning: Linguistic Variables, Fuzzy Logic, Approximate and Plausible Reasoning, Fuzzy Languages.

Fuzzy Sets and Expert Systems: Introduction to Expert Systems, Uncertainty Modeling in Expert Systems, Applications.

Text Book:

1. H.-J. Zimmermann,"Fuzzy Set Theory-and Its Applications", Fourth Edition, Springer Science+Business Media, LLC.

Reference Books:

1. Kwang H.Lee, "First course on Fuzzy Theory and Applications", Springer, 2005.
2. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic -Theory and Applications", Prentice Hall.

CT 592 – Natural Language Processing

Lecture: 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

Course Learning Objectives: At the end of the Course Students will understand

1. Underlying concepts and techniques required for natural language processing.
2. Approaches to syntax and semantics in NLP.
3. Computational models for enabling effective natural language processing.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Determine the structural components of sentences for a given Grammar.
2. Produce logical form that represents context-independent meaning of a sentence.
3. Link logical forms with syntactic structures for semantic interpretation of the sentence.
4. Understand the ambiguity in natural language constructs and identify possible interpretations of a sentence.
5. Map the logical form to the Knowledge representation to generate contextual representation.

UNIT-I: **[9 Periods]**

INTRODUCTION TO NATURAL LANGUAGE UNDERSTANDING: Applications of Natural Language Understanding, Evaluating language Understanding Systems, The Different levels of Language Analysis.

GRAMMARS AND PARSING: Grammars and Sentence Structure, Top- down parser, Bottom up chart parser, Transition network grammars, Top-down chart parsing, finite state models and Morphological processing.

UNIT-II: **[9 Periods]**

FEATURES AND AUGMENTED GRAMMARS: Feature Systems and Augmented Grammars ,Morphological Analysis and the Lexicon, A Simple Grammar Using Features, Parsing with Features, Augmented Transition Networks.

GRAMMARS FOR NATURAL LANGUAGE: Auxiliary Verbs and Verb Phrases, Movement Phenomenon In Language, Handling Questions in Context-Free Grammars.

UNIT-III: **[9 Periods]**

TOWARD EFFICIENT PARSING: Human preferences in parsing, Encoding Uncertainty-Shift-Reduce Parsers, A Deterministic Parser.

AMBIGUITY RESOLUTION: Statistical Methods: Part of Speech tagging, Obtaining lexical probabilities, Probabilistic Context-Free Grammars, Best-First Parsing.

UNIT-IV: **[9 Periods]**

SEMANTICS AND LOGICAL FORM: Semantics and Logical Form Word Senses and Ambiguity, The Basic Logical Form Language, Encoding Ambiguity in the Logical Form, Verbs and States in Logical Form.

LINKING SYNTAX AND SEMANTICS: Semantic Interpretation and Compositionality, A Simple grammar and Lexicon with Semantic Interpretation, Prepositional Phrases and Verb Phrases.

Unit-V: **[9 Periods]**

AMBIGUITY RESOLUTION: Selectional Restrictions, Semantic Filtering Using Selectional Restrictions, Statistical Word Sense Disambiguation. Scoping and the Interpretation of Noun Phrases: Scoping Phenomena, Definite Descriptions and Scoping.

USING WORLD KNOWLEDGE: Using world knowledge: Establishing Coherence, Matching against Expectations, Reference and Matching Expectations, Using Knowledge About Action and Casuality, Scripts: Understanding Stereotypical Situations

Text Book:

1. James Allen, Natural Language Understanding, Second Edition, Pearson Education.

Reference Books:

1. Daniel Jurafsky, James H.Martin, Speech and Language Processing.
2. Christopher Manning, HinrichSchutze, “Foundations of Statistical Natural Language Processing”, MIT Press.
3. Elaine Rich and Kevin Knight, “Artificial Intelligence”, Second Edition, Tata McGraw Hill.
4. www.pcai.com/web/ai_info/natural_lang_proc.html.
5. www.pcai.com/web/ai_info/natural_long_proc.html.
6. https://en.wikipedia.org/wiki/natural_language_processing.

CT 593 – Software Architecture

Lecture: 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

Course Learning Objectives: At the end of the Course Students will understand

1. Software architectural requirements and drivers.
2. Architectural styles and views.
3. Architectures for emerging technologies.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Explain influence of software architecture on business and technical activities.
2. Identify key architectural quality.
3. Use Architectural views.
4. Use Architectural definitions, styles and views required for design.
5. Design document for the developed architectures.

UNIT-I: **[9 Periods]**

INTRODUCTION AND ARCHITECTURAL DRIVERS -- Introduction – What is software architecture? – Standard Definitions – Architectural structures – Influence of software architecture on organization-both business and technical – Architecture Business Cycle- Introduction – Functional requirements – Technical constraints – Quality Attributes.

UNIT – II: **[9 Periods]**

QUALITY ATTRIBUTE WORKSHOP -- Quality Attribute Workshop – Documenting Quality Attributes – Six part scenarios – Case studies.

UNIT – III: **[9 Periods]**

ARCHITECTURAL VIEWS -- Introduction – Standard Definitions for views – Structures and views - Representing views-available notations – Standard views – 4+1 view of RUP, Siemens 4 views, SEI's perspectives and views – Case studies

UNIT – IV: **[9 Periods]**

ARCHITECTURAL STYLES -- Introduction – Data flow styles – Call-return styles – Shared Information styles - Event styles – Case studies for each style.

UNIT –V: **[9 Periods]**

DOCUMENTING THE ARCHITECTURE -- Good practices – Documenting the Views using UML – Merits and Demerits of using visual languages – Need for formal languages - Architectural Description Languages – ACME – Case studies. Special topics: SOA and Web services – Cloud Computing – Adaptive structures

Text Books:

1. Len Bass, Paul Clements, and Rick Kazman, “Software Architectures Principles and Practices”, 2 nd Edition, Addison-Wesley, 2003.
2. Anthony J Lattanze, “Architecting Software Intensive System. A Practitioner's Guide”, CRC Press, 2010.

Reference Books:

1. Paul Clements, Felix Bachmann, Len Bass, David Garlan, James Ivers, Reed Little, Paulo Merson, Robert Nord, and Judith Stafford, “Documenting Software Architectures. Views and Beyond”, 2nd Edition, Addison-Wesley, 2010.
2. Paul Clements, Rick Kazman, and Mark Klein, “Evaluating software architectures: Methods and case studies. Addison-Wesley, 2001.

CT 594 – Semantic Web

Lecture: 4 Periods/Week **Internal: 40 Marks**
Practical: -- **External: 60 Marks**
Credits: 3

Course Learning Objectives: At the end of the Course Students will understand

1. The basic concepts of Traditional Web and Semantic Web and RDF Structures.
2. The concepts of Web Ontology Language and Inference rules.
3. The concepts of Ontology's and Semantic Web search engine and services.

Course Learning Outcomes: After successful completion of this course, student will be able to

1. Familiar with Semantic Web technologies.
2. Write RDF for Semantic Web-systems.
3. Analyze Semantic web structures by using OWL and Inference rules.
4. Use Ontologies in Semantic Web-system.
5. Develop Semantic Web applications.

UNIT I: **[10 Periods]**

Introduction: The world of the semantic web-WWW-meta data-Search engine-Search engine for traditional web-Semantic web-Search engine for semantic web-Traditional web to semantic web.

UNIT II: **[10 Periods]**

Describing Web Resources: RDF, Basic Ideas, XML Based Syntax RDF Schema **RDF and RDF**

Schema in RDF Schema: Basic Ideas, The Language, An Axiomatic Semantics for RDF and RDF Schema, A Direct Inference System for RDF and RDFS, Querying in RQL.

UNIT III: **[10 Periods]**

Web Ontology Language OWL: The OWL Language, OWL in OWL, Future Extension

Logic and Inference-Rules: Monotonic Rules- syntax, semantics, Rule Markup in XML, Non monotonic Rules- syntax, semantics, Rule Markup in XML

UNIT IV: **[10 Periods]**

Ontology Engineering: Constructing Ontologies Manually, Reusing Existing Ontologies,

Using Semiautomatic Methods: OnToKnowledge Semantic Web Architecture, Application project

UNIT V: SEMANTIC WEB SERVICES **[10 Periods]**

Swoogle: Swoogle, FOAF, Semantic markup Issues, prototype system, Design of Semantic web search engine, prototype system-case study.

Semantic Web Services: Semantic web services, OWL-S, Upper ontology, WSDL-S, OWL-S to UDDI mapping, Design of the search engine, implementations

Text Books:

1. Antoniou Grigoris , Groth Paul, Harmelen Frank Van, Hoekstra Rinke, “A Semantic Web Primer” , 3ed , PHI pub.
2. Liyang Yu, “Semantic Web and Semantic Web Services”, CRC 2007.

Reference Books:

1. Karin K Brietman, Marco Antonio Casanova, Walter Truszkowski, “Semantic Web – Concepts”, Technologies and Applications. Springer 2007.
2. Pascal Hitzler, Markus Krotzsch, Sebastian Rudolph, ”Foundations of Semantic Web Technologies”, CRC Press.

CT 551 – Advanced Programming Lab

Lecture: -- **Internal: 40 Marks**
Practical: 3 Periods/Week **External: 60 Marks**
Credits: 2

CT 552 – Advanced Data Base Management Systems Lab

Lecture: -- **Internal: 40 Marks**
Practical: 3 Periods/Week **External: 60 Marks**
Credits: 2

CT 561 – Machine Learning Lab

Lecture: -- **Internal: 40 Marks**
Practical: 3 Periods/Week **External: 60 Marks**
Credits: 2

CT 562 – Industry Related Lab

Lecture: -- **Internal: 40 Marks**
Practical: 3 Periods/Week **External: 60 Marks**
Credits: 2

Laboratory work will be based on syllabus with minimum 10 experiments to be incorporated.

The self-study contents will be declared at the commencement of semester. Around 50% of the Questions will be asked from self-study contents.