2-Years Master of Technology (M. Tech.)
Syllabus for Computer Science and Engineering (CSE)

Third Semester

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	**T**	**P**	
Theory					
TIU-PCS-E#	Elective –IV	3	1	0	4
TIU-PCS-E#	Elective – V	3	1	0	4
Practical					
TIU-PCS-S201	Technical Seminar-II	0	0	3	2
TIU-PCS-D299	Thesis Proposal	0	3	0	8
Sessional					
TIU-PES-S299	Entrepreneurship Skill Development	0	0	2	2
Total Credits					**20**

ELECTIVE – IV					
TIU-PCS-E201	Natural Language Processing (NLP) and Information Retrieval (IR)	3	1	0	4
TIU-PCS-E203	Digital VLSI Design	3	1	0	4
TIU-PCS-E205	Data Warehousing and Data Mining	3	1	0	4
TIU-PCS-E207	Computational Geometry	3	1	0	4

ELECTIVE – V					
TIU-PCS-E209	Pattern Recognition and Image Processing	3	1	0	4
TIU-PCS-E211	Software Project Management and Testing	3	1	0	4
TIU-PCS-E213	Data and Knowledge Security	3	1	0	4

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<u>Syllabus</u>

NATURAL LANGUAGE PROCESSING AND INFORMATION RETRIEVAL
TIU-PCS-E201

L-T-P:3-1-0   **Credits: 4**

Introduction: Introduction to Natural Language Processing (NLP), Language and Grammar, NLP Applications, Information Retrieval (IR), Grammar Based Language Models, Statistical Language Model, Basic Mathematics for NLP and IR.

Classical Approaches: Introduction, Text Preprocessing, Corpus Creation, Word Level Analysis, Lexical Analysis, Syntactic Parsing, Semantic Analysis, Discourse Processing, Natural Language Generation.

Statistical Approaches: Treebank Annotation, Probabilistic models of Information Extraction, Hidden Markov Models (HMM), Maximal Entropy Modeling (MEM), Maximum Entropy Markov Models (MEMM), Conditional Random Fields.

Machine Translation: Problems in Machine Translation (MT), MT Approaches, Knowledge based MT Systems, Machine Translation for Indian Languages.

Information Retrieval: Introduction, Information Retrieval Models, Classical Information Retrieval Models, Non-classical models of IR, Alternative Models of IR, Evaluation of the IR System, Natural Language Processing in IR, Relation Matching, Knowledge-based Approaches, Conceptual Graphs, Cross-lingual Information Retrieval

Applications: Information Extraction, Search Engines, Searching the Web, Clustering Documents, Text Categorization, Automatic Text Summarization, Question-Answering System, NLP applications in Education and Healthcare, BioNLP: Biomedical NLP, Sentiment analysis and subjectivity.

Recommended Books:

Main Reading
1. U.S. Tiwary, Tanveer Siddiqui, Natural Language Processing and Information Retrieval, OUP
2. M Kanchadu, Text Mining Application Programming, Charls River Media

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Supplementary Reading

1. N Indukhya, F.J. Damerau, Handbook of Natural Language Processing, CRC Press

2. R. Feldman, J. Sanger, The Text Mining Handbook, Cambridge

DIGITAL VLSI DESIGN
TIU-PCS-E203

L-T-P:3-1-0   **Credits: 4**

Issues of Digital IC Design : General overview of design hierarchy, layers of abstraction, integration density and Moore's law, VLSI design styles, packaging styles, design automation principles; Logic Design : switch logic, gate restoring logic, Programmable Logic Array (PLAs), Finite State Machine (FSM) as a PLA, personality matrix of a PLA, PLA folding, pseudo-nmos logic, BiCMOS logic gates; Basic Circuit Concepts : sheet resistance and area capacitances of layers, driving large capacitive loads, super-buffers, propagation delay models of cascaded pass transistors, wiring capacitances, switching delay in BiCMOS logic circuits; Bipolar ECL Inverter : features of ECL gate, robustness and noise immunity, logic design in ECL, single-ended and differential ECL gates; Dynamic CMOS design : steady-state behavior of dynamic gate circuits, noise considerations in dynamic design, charge sharing, cascading dynamic gates, domino logic, np- CMOS logic, problems in single-phase clocking, two-phase non-overlapping clocking scheme, different logic families like CPL, DCVSL etc.; Sequential CMOS Logic Circuits : basic regenerative circuits, digital phase-locked loop (DPLL); Low-power CMOS Logic Circuits : low-power design through voltage scaling, estimation and optimization of switching activity, reduction of switched capacitance, adiabatic logic circuits; Subsystem Design : design of arithmetic building blocks like adders and multipliers, barrel and logarithmic shifters, area-time tradeoff, power consumption issues; Semiconductor Memories : Dynamic Random Access Memories (DRAM), Static RAM, non volatile memories, flash memories, low power memory; Case Study (instructor may choose any suitable digital system; in the following, an example is suggested) : A RISC Processor - Instruction Set, Pipeline Architecture, Major Logic Blocks, Layout, Functional Verification.

Recommended Textbooks:
Main Reading

1. S. Kang & Y. Leblebici, "CMOS Digital Integrated Circuits", Mc-Graw Hill
2. R. Geiger, P. E. Allen & N. R. Strader, "VLSI Design Techniques for Analog and Digital

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Circuits", McGraw Hill

3. J. M. Rabaye, A. Chandrakasan& B. Nikolic, "Digital Integrated Circuits: A DesignPerspective", Prentice Hall

4. A. Sarkar, S. De & C. K. Sarkar, "VLSI Design and EDA Tools", Scitech

5. D. Das, "VLSI Design", Oxford

DATA WAREHOUSING AND DATA MINING
TIU-PCS-E205

L-T-P:3-1-0   **Credits: 4**

Data Warehousing: Data warehousing Components –Building a Data warehouse –- Mapping the Data Warehouse to a Multiprocessor, Architecture – DBMS Schemas for Decision Support –Data Extraction, Cleanup, and Transformation Tools Metadata.

Business Analysis: Reporting and Query tools and Applications – Tool Categories – The Need for Applications – Cognos Impromptu –Online Analytical Processing (OLAP) – Need –Multidimensional Data Model – OLAP Guidelines –Multidimensional versus Multirelational OLAP – Categories of Tools – OLAP Tools and the Internet.

Data Mining: Introduction – Data – Types of Data – Data Mining Functionalities – Interestingness of Patterns – Classification of Data Mining Systems – Data Mining Task Primitives –Integration of a Data Mining System with a Data Warehouse– Issues –Data Preprocessing.

Association Rule Mining and Classification: Mining Frequent Patterns, Associations and Correlations – Mining Methods – Mining Various Kinds of Association Rules – Correlation Analysis – Constraint Based Association Mining – Classification and Prediction – Basic Concepts - Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction.

Clustering and Applications in Data Mining
Cluster Analysis - Types of Data – Categorization of Major Clustering Methods - Kmeans– Partitioning Methods –Hierarchical Methods - Density-Based Methods –Grid Based Methods – Model-Based Clustering Methods –Clustering High Dimensional Data - Constraint – Based Cluster Analysis – Outlier Analysis – Data Mining Applications.

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Recommended Books:

Main Reading:

1. Data Warehousing, Data Mining & OLAP, Alex Berson and Stephen J. Smith, Tata McGraw–Hill Edition.
2. Data Mining Concepts and Techniques, Jiawei Han and Micheline Kamber, Jian Pei, Third Edition, Elsevier.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction To Data Mining, Pearson Education.

Supplementary Reading:

1.Insight into Data mining Theory and Practice, Soman K.P., Shyam Diwakar and V. Ajay, Easter Economy Edition, Prentice Hall of India.
2. Introduction to Data Mining with Case Studies, Gupta G. K., Easter Economy Edition, Prentice Hall of India.
3. Data Mining Methods and Models, Daniel T. Larose ,Wile-Interscience.

COMPUTATIONAL GEOMETRY
TIU-PCS-E207

L-T-P:3-1-0   **Credits: 4**

Introduction: historical perspective, geometric preliminaries. Convex hulls algorithms in 2d and 3d, lower bounds.
Triangulations: polygon triangulations, representations, point-set triangulations.
Voronoi Diagrams: algorithms, closest pair problems.
Delaunay Triangulations: algorithms (divide-and-conquer, flip, incremental), duality of Voronoi diagrams, properties (min-max angle).
Geometric Searching: point-location, 2d linear programming with prune and search. Visibility: algorithms for weak and strong visibility, visibility with reflections, art-gallery problems.
Arrangements of Lines: 2d arrangements, zone theorem, many-faces complexity, algorithms.
Sweep Techniques: plane sweep for segment intersections, Fortune's sweep for Voronoi diagrams, topological sweep for line arrangements.
Combinatorial Geometry: Ham-sandwich cuts, Helly's theorems, k-sets.

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Rectilinear Geometry: intersection and union of rectangles, rectangle searching. Robust geometric computing. Applications of computational geometry.

Recommended Books:

Main Reading

1. Mark de Berg, Otfried Schwarzkopf, Marc van Kreveld and Mark Overmars, Computational Geometry: Algorithms and Applications, Springer.
2. F. P. Preparata and Michael I. Shamos, Computational Geometry: An Introduction, Springer.

Supplementary Reading:

1. Joseph O' Rourke, Computational Geometry in C, Cambridge University Press.

PATTERN RECOGNITION AND IMAGE PROCESSING
TIU-PCS-E209

L-T-P:3-1-0   **Credits: 4**

Pattern Recognition: Fundamental problems in Pattern recognition system design, Representation of patterns and classes, Metric and non-metric proximity (E-Distance, Mahalanobis distance, Housdroff distance, cosine angle, Kullback-Leibler Distance) pattern classification by distance function, (minimum distance, single prototype, multi-prototype), Cluster seeking, K-means algorithm, ISO-data algorithm, feature extraction, different approaches to feature selection (exhaustive search, branch and bound), pattern classification by likelihood functions, Bayes classifier, Trainable pattern classifier - the deterministic approach (the perceptron approach, the reward-punishment concept).

Image Processing: Digitization of images, introduction to image analysis problems, segmentation of gray level image Histogram of gray level images, edge detection and region growing techniques (with Lapcian operators, Sobel operator), multispectral images(remote sensing imagery), supervised classification, elements of texture description (co-occurrence matrix), and classification.

Recommended Books:

Main Reading
1. R. O.Duda, P E Hart and D G Stork , Pattern Classification, Wiley publisher.
2. J. T.Tou and R C Gonzalez, Pattern recognition principles, Addison Wesley Publishing.

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Supplementary Reading

1.Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer India

2. Jain, Fundamentals of Digital Image Processing, PHI

SOFTWARE PROJECT MANAGEMENT AND TESTING
TIU-PCS-E211

L-T-P:3-1-0   **Credits: 4**

Module I (S/W Project Management):

Introduction to Software Project Management: Overview of project, project management, Project management process, Activities of project management, setting objectives, plans, methods and methodologies, setting objectives, project success and failures.

SW Project life cycle: Concept, analysis, planning, execution and closing stage, The ISO 12207 Software development life cycle, Project selection **m**ethodologies and technologies, process models, selection of appropriate process model.

SW Project evaluation & Planning: Tools and techniques, funds flow analysis, cost-benefit analysis, risk evaluation, project portfolio management, benefit management, Gathering requirements, Identification of project scope, step wise project planning, case study.

Software project estimation: Software effort estimation techniques, cost estimation, effect of schedule compression, Capers Jone's estimation.

Design of software project management system: Activity planning, Work breakdown structures, product breakdown structure, resource break-down structure, project scheduling, activity on arrow, activity on node, dummy activities, Use of Gantt chart, formulating a network (CPM), activity float, and critical activity

Project Risk management: Project risk identification, assessment, planning, and management, evaluating risks to schedule, application of PERT.

Project Cost Analysis: Resource Allocation, schedule resources, crashing and resource sharing, network scheduling with Limited Resources, capacity planning and capacity expansion decision

Software Project organizations & Managing people in software environment: Functional, matrix and

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projectized organization, various team structures, Organization behavior, coordination and procedures, project management and procedure, working in teams, skills and competency of the manager

Scope and software quality control: Importance of software quality, SQC, SQA, product process and quality, cost of quality, ISO 9126, Process capability models, quality management system, software testing and reliability.

Module II (SW Testing):

Introduction: Introduction to software testing, software testing terminology and methodology, verification and validation, evolution of testing, software testing life cycle, V-model for software testing, testing and debugging, levels of testing, software defect management, flow graphs, code-based testing, logic based testing, configuration management, risk analysis, model based testing, statistical testing, formal testing.

Testing Techniques:

Dynamic testing: white-box testing techniques

Static testing: Slice based testing, mutation testing, coverage analysis, defect seeding

Regression testing: Regression test process, test case selection, test case prioritization, code based and model based regression testing.

Testing Process:

Test planning: Test policy, test strategy, quality plan and test plan, test estimation, test scenario, test scripts, test log document, generation of test data, test progress monitoring,

Test metrics and test reports: Testing data, categories of product test metrics, resource consumed in testing, defect density, test reports, project test status reports, integration, system and acceptance test report, test process improvement, benchmarking.

Testing Strategies:

Integration and System Testing: Top down and bottom up integration, bi-directional integration, system integration, scenario testing, defect bash, functional versus non-functional testing, design/architecture verification, deployment testing, scalability testing, reliability testing, stress testing

Acceptance Testing: Acceptance testing criteria, alpha, beta and gamma testing , acceptance testing during each phase of SDLC, criticality of requirements, software acceptance plan, user's responsibility.

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Test Management and Automation: Software test automation, scope of automation, design & architecture for automation, FSM based testing; generic requirements for test tool framework, testing tools selection, testing in object oriented systems, testing web-based systems.

Current Research and Emerging Trends in software testing

Recommended Books:

Main Reading:

1. Bob Hughes, Mike Cotterell, Rajib Mall, Software Project Management, McGraw-Hill

2. R. Walker, Software Project Management, Pearson

3. William E. Perry, Effective Methods of Software Testing, Wiley India

4. Naresh Chouhan, Software Testing, Oxford University Press

Supplementary Reading:

1. Jerome D. Wiest, Ferdinand K. Levy, A Management Guide to PERT/CPM, PHI

2. Robert K. Wysocki, Effective Software Project Management, Wiley India

3. Testing Computer Software, CemKaner, Jack Falk, Hung Quoc Nguyen, Wiley India.

4. M.G.Limaye, Software Testing – Principles, Techniques and Tools, Tata McGraw-Hill.

5. Paul C. Jorgensen, Software Testing - A Craftsman's approach, Auerbach Publications.

6. Aditya P. Mathur, Foundations of Software Testing, Pearson Education

DATA AND KNOWLEDGE SECURITY
TIU-PCS-E213

L-T-P:3-1-0   **Credits: 4**

Data Security: Database systems- architectures- storage structures- storage issues in Database Management Systems- Security of data at various levels of Database Management Systems

Distributed Databases: Distributed Data Processing- Distributed Database system- Distributed Database

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Management System Architecture: Architectural models for Distributed Database Management System – Global directory issues – Distributed database design – distributed design issues – fragmentation – Allocation

Semantic Data Control: View Management – Data centralized Authorization control – Distributed Authorization control – centralized Semantic Integrity Control - Centralized Semantic Integrity Control - Database interoperability- issues related to security in database interoperability

Knowledge base systems - Knowledge base system design – storage of knowledge – various formats – Levels of security issues in Knowledge base system design – conceptual level – implementation level

Expert Systems – Design of Expert systems – Knowledge representation techniques in Expert system – structured, semi structured and unstructured data – Knowledge Management and security issues.

Recommended Reading:

Main Reading:
1. Security in Computing, Charles P. Pfleeger and Shari Lawrence Pfleeger, Third Edition, Pearson Education.

Supplementary Reading:
  1.M.Tamer OZSU and Patrick Valdureiz, Principles of Distributed Database Systems, Second Edition, Pearson Education.
  2. Artificial Intelligence: A Modern approach, Stuart Russel and Peter Norwig, Third Edition, Pearson Education.
3. Ganesh Natarajan and Sandhya Shekhar, Knowledge Management, Tata Mc-GrawHill.

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