TECHNO INDIA UNIVERSITY
WEST BENGAL

**Department of Electronics and Communication Engineering**

**Fifth Semester**

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| **Program:**B.Tech in Electronics &Communication Engineering | **Year, Semester:** 3rd YR. 5th SEMESTER |
| **Course Title:**CAD for VLSI | **Subject Code:** TIU-UEC-S303 |
| **Contact Hours/Week**: 2–0–0 (L–T–P) | **Credit:** 2 |

Course Objective:

This course provides an in-depth understanding of VLSI design methodologies, CAD tools, and automation techniques. It covers logic synthesis, simulation, and physical design automation with a focus on industry-standard EDA tools

Course Outcomes (COs)

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|---|---|---|
| CO-1: | Explain the VLSI design flow, different types of VLSI design, and the role of CAD tools in design automation. | K2 |
| CO-2: | Demonstrate proficiency in Hardware Description Languages (HDL) such as Verilog and VHDL for RTL design. | K3 |
| CO-3: | Apply logic synthesis techniques for combinational and sequential circuits using Boolean algebra and minimization methods | K4 |
| CO-4: | Analyze the principles of physical design automation, including partitioning, floor planning, placement, and routing. | K4 |
| CO-5: | Use EDA tools for simulation and verification of digital circuits at different abstraction levels. | K2 |
| CO-6: | Evaluate the efficiency of VLSI designs in terms of performance, power, and area constraints | K3 |

**COURSE CONTENT:**

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|---|---|---|
| **MODULE 1:** | **Introduction to VLSI Design and CAD Tools** | **10 Hours** |

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| Overview of VLSI Design: Design flow, types of VLSI design (ASIC, FPGA, Full Custom, Semi-Custom)<br>CAD in VLSI: Role of CAD tools, design automation, design constraints, and requirements<br>VLSI Design Flow: System specification, RTL design, synthesis, physical design, verification<br>EDA Tools: Overview of tools (Cadence, Synopsys, Mentor Graphics)<br>Hierarchy in VLSI Design: Hierarchical design approach, partitioning of design tasks. | | |
| **MODULE 2:** | **Logic Synthesis and Simulation** | **10 Hours** |
| Hardware Description Languages: Verilog, VHDL, SystemVerilog; coding styles, RTL design<br>Logic Synthesis: Concepts, technology-independent vs. technology-dependent synthesis<br>Gate-Level Minimization: Boolean algebra, Karnaugh maps, Quine-McCluskey algorithm<br>Combinational and Sequential Circuit Synthesis: Logic synthesis approaches<br>Simulation Techniques: Functional, timing, and gate-level simulation; fault simulation | | |
| **MODULE 3:** | **Physical Design Automation** | **10 Hours** |
| • Introduction to Physical Design: Objectives, layout stages, layout styles<br>• Partitioning: Min-cut, recursive, Kernighan-Lin, Fiduccia-Mattheyses algorithms<br>• Floorplanning and Placement: Basics, constraints, floorplanning algorithms, placement objectives<br>• Routing: Global vs. detailed routing, channel and switchbox routing, Maze and Steiner tree algorithms<br>• Compaction: Problem formulation, techniques, and algorithms | | |
| **Total Hours** | | **30 Hours** |

**Text Books**


1. **"CMOS VLSI Design: A Circuits and Systems Perspective"** – Neil H. E. Weste and David Money Harris
2. **"Principles of CMOS VLSI Design"** – Neil H. E. Weste and Kamran Eshraghian
3. **"VLSI Design Methodologies" –** Giovanni De Micheli.


Reference Books:


4. **"Basic VLSI Design"** – Douglas A. Pucknell and Kamran Eshraghian.
5. **"Digital Integrated Circuits: A Design Perspective"** – Jan M. Rabaey
6. **"Introduction to VLSI Circuits and Systems"** – John P. Uyemura


**Department of Electronics and Communication Engineering**

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| **Program:** B.Tech. in ECE | **Year, Semester:** 3rd, 5th. |
| **Course Title:** SAP (SAPS/4HANA) | **Subject Code:***TIU-UTR-T301* |

| **Contact Hours/Week**: 2–0–0 | **Credit:** 2 |
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**COURSE OBJECTIVE:**

Enable the student to:

1. Understand and Navigate SAPS/4HANA Architecture
2. Master core functional modules in SAPS/4HANA
3. Implement and optimize SAPS/4HANA for business transformation.

**COURSE OUTCOME:**

On completion of the course, the student will be able to:

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|---|---|---|
| CO-1: | Define the fundamental concepts of SAP S/4HANA, including its architecture, modules, and key business processes. | K1 |
| CO-2: | Explain the differences between SAP ECC and SAP S/4HANA, including key innovations like the Universal Journal, SAP Fiori, and HANA database capabilities. | K2 |
| CO-3: | Demonstrate the navigation of the SAP S/4HANA interface and execute basic transactions in core modules like Finance (FI), Materials Management (MM), and Sales & Distribution (SD). | K3 |
| CO-4: | Implement fundamental business processes in SAP S/4HANA, such as procure-to-pay, order-to-cash, and record-to-report, using standard SAP functionalities. | K3 |
| CO-5: | Analyze real-time analytics and reporting capabilities in SAP S/4HANA, utilizing SAP Fiori applications and embedded analytics. | K4 |
| CO-6: | Evaluate SAP S/4HANA deployment options (on-premise, cloud, and hybrid) and their impact on business transformation and digital innovation. | K4 |

**COURSE CONTENT:**

| **MODULE 1:** | **Building Tomorrow's ERP with SAP S/4HANA** | **6 Hours** |
|---|---|---|
| The Future of ERP<br>Discover the Value of SAPS/4HANA<br>SAPS/4HANA: Scope and Intelligent Processes<br>A Modern User Experiencewith SAP S/4HANA<br>Central Business Configuration for SAPS/4HANACloud | | |
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| **MODULE 2:** | **Navigation in SAPSystems** | **6 Hours** |
| Logon to the system.<br>Initial Screen: Menu Bar, Title Bar,ApplicationToolbar,SAPEasyAccess Menu<br>Favourites:AddT-Code,Folder,URL<br>Transaction Codes<br>User Specific Settings<br>Help Functions | | |

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| **MODULE 3:** | **Introduction to S/4HANA using GBI** | **6 Hours** |
| GBI Business Story<br>SAPS/4HANA Architecture<br>Organizational Structure<br>Products<br>BusinessProcess | | |
| | | |
| **MODULE 4:** | **Sales & Distribution Business Process** | **6 Hours** |
| Overview of SD<br>Creating Master Data<br>Sales order process<br>Pre-sales Activities<br>Shipping,Billing,CreditManagement | | |
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| **MODULE 5:** | **Integrated Materials Management Process** | **6 Hours** |
| Overview of Material Management<br>MMorganizationstructure<br>Creating Master Data<br>Purchasing InformationR<br>CreatingInvoice,GoodsReceipt,Payment | | |
| **TOTAL LAB HOURS** | | **30 Hours** |

**Department of Electronics and Communication Engineering**

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|---|---|
| **Program:** B.Tech. in ECE | **Year, Semester: 3RD, 5TH** |
| **Course Title:** Computer Architecture and Organization | **Subject Code:** TIU-UCS- T311 |
| **Contact Hours/Week**: 3–0–0 | **Credit: 3** |

**COURSE OBJECTIVE:**

Enable the student to:

1. To introduce the basic concepts and principles of computer architecture, including the organization and structure of modern computer systems.
2. To develop an understanding of the instruction set architecture (ISA) and how it influences processor design and program execution.
3. To explore the design and functioning of various components of the CPU, such as ALU, control unit, registers, and data path.
4. To study memory hierarchy and organization, including cache memory, virtual memory, and memory management techniques.
5. To analyze performance issues and optimization techniques in computer systems, including pipelining, parallelism, and input/output subsystems.

**COURSE OUTCOME:**

On completion of the course, the student will be able to:

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|---|---|---|
| CO-1: | Recall the fundamental components and principles of computer architecture | K1 |
| CO-2: | Explain the working of instruction sets, addressing modes, and data representation formats | K2 |
| CO-3: | Illustrate the design and operation of arithmetic and logic units (ALU) and control units | K2 |
| CO-4: | Apply knowledge of memory systems and hierarchy, including cache and virtual memory, in system design | K3 |
| CO-5: | Demonstrate the functioning of pipelining and its impact on processor performance | K3 |
| CO-6: | Analyze the performance of various architectural design alternatives using suitable metrics. | K4 |

**COURSE CONTENT:**

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|---|---|---|
| **MODULE 1:** | | **6 Hours** |
| Recall the fundamental components and principles of computer architecture, Basic structure and functional units of a computer, Von Neumann vs Harvard architecture, Instruction execution cycle, Introduction to performance metrics (MIPS, FLOPS, CPI), Evolution of processors and trends in computing | | |
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| **MODULE 2:** | | **6 Hours** |
| Instruction Set Architecture (ISA) and Data Representation, Explain the working of instruction sets, addressing modes, and data representation formats, Instruction formats and types (RISC vs CISC), Addressing modes: immediate, direct, indirect, indexed, Data representation: number systems, binary arithmetic, fixed and floating-point formats, Instruction cycle and decoding | | |
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| **MODULE 3:** | | **8 Hours** |
| Arithmetic and Logic Unit (ALU) and Control Unit Design, Illustrate the design and operation of arithmetic and logic units (ALU) and control units, ALU operations: addition, subtraction, multiplication, division, Design of combinational and sequential logic for ALU, Hardwired vs microprogrammed control, Control signals and sequencing | | |
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| **MODULE 4:** | | **6 Hours** |
| Memory Hierarchy and Organization, Apply knowledge of memory systems and hierarchy, including cache and virtual memory, in system design, Memory types: primary, secondary, and tertiary, Cache memory: mapping techniques and replacement policies, Virtual memory: paging and segmentation, Memory management hardware | | |
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| **MODULE 5:** | | **8 Hours** |

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|---|---|---|
| Pipelining and Instruction-Level Parallelism, Demonstrate the functioning of pipelining and its impact on processor performance, Basic pipelining concepts, Pipeline hazards: structural, data, and control, Techniques to overcome hazards, Superscalar and VLIW architectures (introductory) | | |
| MODULE 6: | | 6 **Hours** |
| Performance Analysis and Advanced Topics, Analyze the performance of various architectural design alternatives using suitable metrics, Performance metrics: throughput, latency, CPI, Benchmarks and real-world performance evaluation, Introduction to multi-core and parallel architectures, Case studies and performance comparison | | |
| **TOTAL LAB HOURS** | | **40 Hours** |

**Books:**


1. Computer Architecture: A Quantitative Approach, Authors: John L. Hennessy and David A. Patterson, Publisher: Morgan Kaufmann
2. ComputerArchitecture , Author: Charles Fox, Publisher: No Starch Press
3. Essentials of Computer Architecture, Author: Douglas Comer, Publisher: CRC Press Taylor & Francis
4. Fundamentals of Computer Architecture and Design ,Author: Ahmet Bindal, Publisher: Springer
5. Computer System Architecture,Author: M. Morris Mano,Publisher: Pearson


**Department of Electronics & Communication Engineering**

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| **Program:** B. Tech. in ECE | **Year, Semester:** 3rd Yr., 5th Sem. |
| **Course Title:** EM Theory and Antenna | **Subject Code:** TIU-UEC-T309 |
| **Contact Hours/Week**: 3–1–0 (L–T–P) | **Credit:** 4 |

**COURSE OBJECTIVE:**

Enable the student to:

1. understand fundamental laws and equations of electromagnetic theory and properties of electromagnetic wave in different unbounded media.
2. analyze the concepts and methods of electromagnetic wave propagation through guided structure like transmission line and waveguide.
3. develop fundamental idea on different antenna structures based on the knowledge of electromagnetic theory.

**COURSE OUTCOME:**

On completion of the course, the student will be able to:

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|---|---|---|
| CO-1: | Understand the fundamental concepts of coordinate systems and vector algebra to solve problems related to Electromagnetic Theory and Antenna. | K2 |

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|---|---|---|
| CO-2: | Apply the basic laws of electrostatics and magnetostatics to solve problems of Electromagnetism. | K3 |
| CO-3: | Interpret the concepts of Maxwell equations along with boundary conditions. | K3 |
| CO-4: | Analyze the equations, various properties and propagation of Electromagnetic waves in different media. | K4 |
| CO-5: | Demonstrate the concepts of transmission lines and waveguides for electromagnetic wave propagation in guided media. | K3 |
| CO-6: | Identify the basic concept of antennas for electromagnetic radiation in free space and numerical techniques in electromagnetics. | K2 |

**COURSE CONTENT:**

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| **MODULE 1:** | **6 Hours** |
| Recapitulation of Scalar & Vectors, Gradient, Divergence & Curl and their physical interpretation, Divergence Theorem & Stokes Theorem, Scalar and Vector Potential | |
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| **MODULE 2:** | **6 Hours** |
| Coulomb's law, Electric flux & Gauss Law, Method of images; Biot and Savart Law, Ampere's Law. | |
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| **MODULE 3:** | **6 Hours** |
| Maxwell's equations: Integral & Differential form, its significance, displacement current, equation of continuity, boundary conditions. | |
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| **MODULE 4:** | **6 Hours** |
| Propagation of uniform plane waves in unbounded medium: reflection, refraction, phase and group velocities. | |
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| **MODULE 5:** | **8 Hours** |
| Transmission lines and waveguides: modes, design, travelling waves, standing waves, pulse propagation, characteristic impedance, cut-off frequency, attenuation, dispersion, power-handling capability. | |
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| **MODULE 6:** | **8 Hours** |
| Radiation concept, Antennas: elementary dipole, half-wave dipole, radiation patterns, directivity, gain, Image Theory, Friis Transmission Formula, pattern multiplication, other basic antennas, Microstrip Patch Antennas. | |
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| **MODULE 7:** | **4 Hours** |
| Numerical Technique in Electromagnetics: Method of Moment. | |
| **TOTAL LECTURES** | **44 Hours** |

**Books:**

1. M. N. O. Sadiku, "Principles of Electromagnetics", Oxford University Press.
2. W. H. Hayt& J. A. Buck, "Engineering Electromagnetics", McGraw Hill.
3. E. C. Jordan & K. G. Balmain, "Electromagnetic Waves & Radiating Systems", Prentice Hall.
4. J. D. Kraus, "Antennas", McGraw Hill.
5. J. D. Kraus & D. Fleisch, "Electromagnetics with Applications", McGraw Hill.
6. R. F. Harrington, "Introduction to Electromagnetic Engineering", Dover Publications.

7. J. D. Ryder, “Networks, Lines and Fields”, Pearson.
8. G. S. N. Raju, “Electromagnetic Field Theory and Transmission Lines”, Pearson.
9. G. S. N. Raju, “Antenna and Wave Propagation”, Pearson.
10. J. A. Edminister and M. Nahmi, “Schaum's Outlines in Fundamentals of Electromagnetics”, McGraw Hill.
11.David K. Cheng, “Field and Wave Electromagnetics”.
12.I. J. Bahl and P. Bhartia, “Micro Strip Antennas”, Artech House.
13.R. L. Yadava, “Electromagnetic Fields & Waves”, Khanna Publishing House.
14.R. K. Shevgaonkar, “Electromagnetic Waves”, Tata McGraw Hill.
15.Narayana Rao, “Engineering Electromagnetics”, Prentice Hall of India.
16.K. D. Prasad, “Antennas and Wave Propagation”, Satya Prakashan.

**Department of Electronics and Communication Engineering**

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| **Program:** B. Tech. in ECE | **Year, Semester:** 3rd Yr., 5th Sem. |
| **Course Title:** Analog Communication | **Subject Code:** TIU-UEC-T305 |
| **Contact Hours/Week**: 3–0–0 (L–T–P) | **Credit:** 3 |

**COURSE OBJECTIVE:**

Enable the student to:

| COB | Objectives |
|---|---|
| 1. | To Understand the basic components of a communication system, including transmitters, receivers, and physical channels for communication. |
| 2. | To Study Amplitude Modulation (AM), Frequency Modulation (FM), and Phase Modulation (PM), Pulse modulations along with their characteristics, advantages, and limitations. |
| 3. | To analyze the performance of different modulation schemes with their modulation index, percentage of modulation bandwidth requirements, power efficiency, and signal-to-noise ratio (SNR). |
| 4. | To illustrate the mathematical and graphical representation of spectrums of modulated and demodulated signals. |
| 5. | Toexplore different demodulation techniques for AM, FM, and PM, including envelope detection, synchronous detection, and discriminator circuits. |
| 6. | To study different noise factor related to the analog communication and analyze signal performance in presence of noise signal. |

**COURSE OUTCOME:**

On completion of the course, the student will be able to:

| COs | Outcomes | Level |
|---|---|---|
| 1. | Able to **recognize** the basics of communication system and its all components. | K2 |
| 2. | **Understand** different parts analog modulation schemes, their efficiency, bandwidth and other factors. | K2 |
| 3. | Able to **calculate** different factors of all modulation schemes. | K3 |
| 4. | **Illustrate** mathematical and graphical representations of all modulation schemes, their modulators and demodulators. | K3 |
| 5. | **Analyze** the behavior of a communication system and its limitations. | K4 |
| 6. | **Identify** the performance of communication systems in the presence of noise. | K4 |

**COURSE CONTENT:**

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|---|---|---|
| **MODULE 1:** | | **8 Hours** |
| Modulation, Types, Analysis of Modulation, Sideband and energy consideration, low pass and band pass signals. | | |
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| **MODULE 2:** | | **8 Hours** |
| Demodulation, Types of detection, Analysis of amplitude and frequency modulation; Modulators. | | |
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| **MODULE 3:** | | **10 Hours** |
| Nonlinear modulation techniques, FM and PM, narrowband FM, wideband FM, Generation of FM wave, Classification of FM detectors, Radio transmitters and receivers. | | |
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| **MODULE 4:** | | **10Hours** |
| Sampling a signal by periodic pulse stream: spectra of ideally sampled signal, Nyquist sampling theorem, Discriminator, Slope detector, Staggered tuned discriminator, Foster- Seely discriminator, Analysis of Centre tuned discriminator, Noise Sources in transmitting and receiving systems, Thermal noise, Shot noise, Noise Figure. | | |
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| **MODULE 5:** | | **8 Hours** |
| Time-division multiplexing, Wireless power transfer, Near-field techniques, Far-field techniques, Plasma channel coupling, wireless energy transmission technologies. | | |
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| **TOTAL LECTURES** | | **44 Hours** |

**Books:**

**Text Books**:

1. H. Taub, D. L. Schilling and G. Saha, "Principle of Communication system", McGraw Hill.

2. W. Tomasi, “Electronic Communication System: Fundamentals through Advanced”, Pearson.
3. S. Haykin and M. Moher, “Introduction to Analog and Digital Communication”, Wiley.
4. B.P. Lathi and Z. Ding, “Modern Analog and Digital communication system”, Oxford.

**Department of Electronics & Communication Engineering**

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|---|---|
| **Program:** B. Tech. in ECE | **Year, Semester:** 3RD Yr., 5TH Sem. |
| **Course Title:** MACHINE LEARNING WITH LAB | **Subject Code:** TIU-UEC-C301 |
| **Contact Hours/Week**: 3–0–2 (L–T–P) | **Credit:** 4 |

**COURSE OBJECTIVE:**

Enable the student to:

1. Introduce fundamental concepts of machine learning and familiarize students with different learning paradigms, including supervised, unsupervised, and reinforcement learning.
2. Develop an understanding of key machine learning techniques, such as regression, classification, clustering, and their mathematical foundations, including loss functions and optimization.
3. Provide hands-on experience in implementing machine learning models using Python-based libraries such as Scikit-Learn, TensorFlow, and PyTorch.
4. Preprocess and analyze datasets, including feature selection, dimensionality reduction, and performance evaluation using metrics like cross-validation and confusion matrices.
5. Equip students with the ability to compare and evaluate different machine learning algorithms, considering their accuracy, efficiency, and applicability to real-world problems.

**COURSE OUTCOME:**

On completion of the course, the student will be able to:

| | | |
|---|---|---|
| CO-1: | Define the fundamental concepts of machine learning, including supervised, unsupervised, and reinforcement learning and identify various machine learning algorithms and their applications in real-world scenarios. | K1 |
| CO-2: | Explain the working principles of regression, classification, and clustering techniques. | K2 |
| CO-3: | Interpret the mathematical foundations of machine learning, including loss functions, optimization, and evaluation metrics. | K2 |
| CO-4: | Implement machine learning models using Python libraries such as Scikit-Learn, TensorFlow, or PyTorch | K3 |
| CO-5: | Apply data preprocessing techniques, feature selection, and dimensionality reduction in real datasets and Analyze model performance using cross-validation, confusion matrices, and other evaluation methods. | K3,K4 |
| CO-6: | Compare different machine learning algorithms in terms of accuracy, computational efficiency, and applicability. | K4 |

**COURSE CONTENT:**

| MODULE 1: | | 6 Hours |
|---|---|---|
| Introduction to Machine Learning, Examples of Machine Learning applications -Learning associations, Classification, Regression, Unsupervised Learning, ReinforcementLearning. Supervised learning, Input representation, Hypothesis class, Basic probability Models: probability distribution, Bayesian Theorem, Maximum Likelihood probability, Maximum Aposteriori probability, Least square, introduction to python programming. | | |
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| **MODULE 2:** | | **10 Hours** |
| Simple Linear Regression, Multiple Linear Regression, Estimating the Regression Coefficients, R-squrae value, Assessing the Accuracy of the Model, Qualitative Predictors, Extensions of the Linear Model, Linear Model Selection and Regularization, Subset Selection, Shrinkage Methods, Ridge Regression ,The Lasso, Selecting the Tuning Parameter, Dimension Reduction Methods ,Principal Components Regression(PCA), Partial Least Squares ,High-Dimensional Data ,Regression in High Dimensions ,Interpreting Results in High Dimensions Polynomial regression, implementation by python programming for regression problem | | |
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| **MODULE 3:** | | **10 Hours** |
| Classification problem, Logistic, Multiple & Multinomial Logistic Regression, Estimating the Regression Coefficients, Generative Models for Classification, Linear Discriminant Analysis for different p values, Quadratic Discriminant Analysis, Naive Bayes, K-Nearest Neighbors, Comparison of Classification Methods, Cross validation and re-sampling methods- K-fold cross validation, Bootstrap, implementation by python programming for classification problem | | |
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| **MODULE 4:** | | **10 Hours** |
| Tree-based learning methods ,The Basics of Decision Trees, Regression Trees, Classification Trees ,Trees Versus Linear Models ,Advantages and Disadvantages of Trees, Entropy, Information Gain, Tree construction, ID3, Issues in Decision Tree learning- Avoiding Over-fitting, Reduced Error Pruning, The problem of Missing Attributes, Bagging, Random Forests, Boosting, and Bayesian Additive, Regression Trees, implementation by python programming for tree based problem | | |
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| **MODULE 5:** | | **10 Hours** |
| Support Vector Machine, Maximal Margin Classifier, Classification Using a Separating Hyperplane, Support Vector Classifiers, Support Vector Machines , Classification with Non-Linear Decision Boundaries , Kernel functions. models, Three basic problems of HMMs - Evaluation problem, findingstate sequence, Learning model parameters. Unsupervised Learning - Clustering Methods - K-means, Expectation-Maximization Algorithm, Hierarchical Clustering Methods, Density based clustering, implementation by python programming for SVM problem | | |
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| **TOTAL LECTURES** | | **46 Hours** |

**TEXT BOOKS:**

1. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
2. Ethem Alpayidin, Introduction to Machine Learning (Adaptive Computation and machine Learning), MIT Press, 2004.
3. Margaret H. Dunham, Data Mining: Introductory and Advanced Topics, Pearson, 2006.
4. Mitchell T., Machine Learning, McGraw Hill.
5. Ryszard S. Michalski, Jaime G. Carbonell, and Tom M. Mitchell, Machine Learning : An