

Course details: 4th Year Even Semester

ECE 4211 VLSI Design Credits: 3

VLSI design methodology: top-down design approach, technology trends.

MOS technology: Introduction to Microelectronics and MOS Technology, Basic Electrical Properties and Circuit Design Processes of MOS and Bi CMOS Circuits,, MOS, NMOS, CMOS inverters, pass transistor and pass gates, DC and transient characteristics.

Overview of fabrication process: NMOS, PMOS, CMOS, Bi-CMOS process.

NMOS and CMOS layout: Color plate Stick diagram, and design rules.

CMOS circuit characteristics: Resistance and capacitance, rise and fall time, power estimation.

Introduction to Bi-CMOS circuits: Shifter, an ALU Sub-System, adder, counter, multipliers, multiplexer. Data Path and memory structures, Buffer circuit design, DCVS Logic.

Design and Test-Ability: Circuit partitioning, Floor planning and placement, Routing, Practical Aspects of Design Tools and Test-Ability MOS Design, Behavioral Description, Structural Description, Physical Description and Design Verification

ECE 4223 Digital Image Processing Credits: 3

Digital Image Fundamentals: Different types of digital images, sampling and quantization, imaging geometry, image acquisition systems.

Bilevel Image Processing: Basic concepts of digital distances, distance transform, medial axis transform, component labeling, thinning, morphological processing, extension to grey scale morphology.

Binarization of Grey level images: Histogram of grey level images, optimal thresholding using Bayesian classification, multilevel thresholding.

Detection of edges : First order and second order edge operators, multi-scale edge detection, Canny's edge detection algorithm, Hough transform for detecting lines and curves, edge linking.

Images Enhancement: Point processing, Spatial Filtering, Frequency domain filtering, multi-spectral image enhancement, image restoration.

Image Segmentation: Segmentation of grey level images, Water shade algorithm for segmenting grey level image. Image representation and description, recognition and interpretation.

Image compression: Lossy and lossless compression schemes, prediction based compression schemes, vector quantization, sub-band encoding schemes, JPEG compression standard, Fractal compression scheme, Wavelet compression scheme.

ECE 4224 Digital Image Processing Sessional Credits: 0.75

Sessional based on the theory of course ECE 4223.

ECE 4217 Control Systems Credits: 3.00

Introductory Concepts: Open loop versus closed loop feedback system. Input output relationship. Transfer function.

DC machine dynamics, performance criteria, sensitivity and accuracy. Analysis of control systems time and frequency domain error constants.

Stability of control system : Routh-Hurwitz criterion, bode plot, polar plot. Nyquist method.

Root locus techniques. Frequency response analysis. Nicholes chart, compensation. Introduction to non-linear control system. State variable characterization of systems, transition matrix, canonical forms. Controllability and observability.

ECE 4218 Control Systems Sessional Credits: 0.75

Sessional based on the theory of course ECE 4217.

Optional Course Details for the 4th year Even Semester

Optional III

ECE 4221 Contact hours/week: 3

Unix Programming Credit: 3

Introduction: Introduction to Unix Programming.

Unix Environment: command line, globbing, I/O redirection, piping, Basic commands, Memory layout.

Debugging: GDB, valgrind, essential x86, Fork, exec, wait, Process status, bit manipulation, sending signals Unix I/O Implementing I/O redirection, piping Directories and files. Walking a directory tree, exploring attributes. Implementing ls -l. Permissions, file owner / group, time-stamps. Signals and signal handling Design / implementation of sleep Process Relationships Backgrounding. Popen / pclose Midterm Terminal handling Review midterm Networking Client / Server. I/O multiplexing.

Multi-threading: basics, mutual exclusion Multi-threading: bounded buffers, condition variables Multi-threading: deadlocks Non-blocking I/O. Regular expressions. Sys V IPC. Semaphores and shared memory. Shell scripting.

ECE 4222 Unix Programming Contact hours/week: 3/2

Sessional based on the theory of course ECE 4221 **Credits: 0.75**

ECE 4227 Contact hours/week: 3

Network Security Credits: 3

Introduction: Network security policies, strategies and guidelines; Network security assessments and matrices;

Different attacks: Denial of Service attack (DoS), Distributed Denial of Service (DDoS) attack, Eavesdropping, IP spoofing, Sybil attack, Blackhole attack, Grayhole attack, Man-in-the-middle attack, Passwords-based offline attacks;

Network security threats and attackers: Intruders, Malicious software, Viruses and Spy-ware; Security standards: DES, RSA, DHA, Digital Signature Algorithm (DSA), SHA, AES; Security at Transport layer: Secure Socket Layer (SSL) and Transport Layer Security (TLS);

Security on Network layer: IPSec; Network security applications: AAA standards, e-mail securities, PGP, S/MIME; PKI smart cards; Sandboxing; Firewalls and Proxy server;

Security for wireless network protocols: WEP, WPA, TKIP, EAP, LEAP; Security protocols for Ad-hoc network; Security protocols for Sensor network; Security for communication protocols; Security for operating system and mobile agents; Security for e-commerce; Security for LAN and WAN; Switching and routing security; Other state-of-the-art related topics.

ECE 4228 Network Security Contact hours/week: 3/2

Sessional based on the theory of course ECE **Contact Hours/week: 3**

4227 Credits: 0.75 **ECE 4237**

Parallel and Distributed Processing

Credits:3

Multithreaded computing: Basic concepts: processes, threads, scheduling, Multithreaded programming, Thread synchronization: semaphores, locks, monitors , Concurrency issues: deadlock, starvation , Multi-core computers.

Networked computers: Basic concepts: client-server, connections, datagrams, Application protocol design , Client-side socket programming ,Server-side socket programming, Datagram programming.

Network protocols and security: Physical/data link/network/transport/application layers, Network security.

Distributed systems: Architectures: Two-tier, multi-tier, peer-to-peer, many-to-many, Middleware: distributed objects, web services.

Parallel computing: Architectures: SMP, cluster, hybrid, grid, GPGPU ,Middleware: OpenMP, MPI, grid middleware.

ECE 4238 Parallel and Distributed Processing Sessional Contact hours/week: 3/2

Sessional based on the theory of course ECE 4237 **Credits: 0.75**

ECE 4239 Contact hours/week: 3 Computer Graphics and Animations Credits: 3

Introduction: History, Application of Computer Graphics (Computer Aided Design Animation), A Survey of Graphics I/O Devices and Types.

Graphics Software Design: Survey of Desired Function, Toward a Universal Graphic Language. Display Files, Databases for Pictorial Applications.

Graphics Techniques: Point-Plotting Techniques, Line Drawing, Geometric Transformations, Windowing and Clipping, Raster Graphics.

Hardware for Computer Graphics: Typical Small and Large System, Graphic Terminals, Plotters, Graphic Display Processors, Device Independent Graphics Systems.

Graphics Software: A Simple Graphic Package, Segmented Display Files, Geometric Models, Picture Structure.

Interactive Graphics: Input Techniques, Event Handling, Three-Dimensional Graphics, Curves and Surfaces, 3-D Transformation.

Hidden Surface Problem: Back Face Removal, Hidden-Line Removal Curved Surfaces, Describing Points, Lines And Polygons, Some Hints For Building Polygonal Models, Color Perception, RGBA and Color Index Mode, Dithering, Blending, 3-D Blending With The Depth Buffer, Antialiasing, Fog, Fog Equations, The OpenGL ARB.

API Specifies: Data Types, Function Naming Conventions, Platform Independence, Drawing Shapes With OpenGL, Animation With OpenGL And GLUT.

Drawing in Space: Lines, Points and Polygons.

Co-ordinate Transformations: Understanding Transformations, Matrix Munching Projections, Matrix Manipulation Color Lighting and Materials, Texture Mapping.

ECE 4240 Computer Graphics and Animations Contact hours/week: 3/2

Sessional based on the theory of course ECE 4239 Credits: 0.75

ECE 4241 Contact hours/week: 3

Computer Vision Credits: 3

Introduction: Introduction to Computer Vision, Case study-Face Recognition, Linear Algebra/Probability Review.

Image Structure: Linear Filters, Finding Lines-From Detection to Model Fitting, Clustering and Segmentation.

Camera Models: Camera Models, Camera Calibration, Epipolar Geometry, Stereo & Multi-view Reconstruction.

Recognition (Building blocks): Detectors and Descriptors, SIFT & Single Object Recognition, Optical Flow & Tracking.

Recognition (Objects, Scenes, and Activities): Introduction to Object Recognition and Bag-of-Words Models, Object classification and detection- a part-based generative model (Constellation model), Object Classification and

Detection: a Part-based Discriminative Model (Latent SVM), Human Motion Recognition.

Computer Vision: State-of-the-art and the Future.

ECE 4242 Computer Vision Sessional Contact hours/week: 3/2

Sessional based on the theory of course ECE 4241 **Credits: 0.75**

ECE 4243 Contact hours/week: 3

Data Mining Credits: 3

Data Mining and Applications: Relational Databases, Data Warehouses, Transactional Databases, Advanced Data and Information Systems, Characterization and Discrimination, Mining Frequent Patterns, Associations, and Correlations, Classification and Prediction, Cluster Analysis, Outlier Analysis, Evolution Analysis.

Data Preprocessing: Descriptive Data Summarization, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation.

Classification, Clustering and Prediction: Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Back propagation, Support Vector Machines, Clustering by Partitioning/ Hierarchical/ Density-based/ Grid-based/ Model-based methods, Clustering High-Dimensional Data, Outlier analysis, Prediction, Linear Regression, Nonlinear Regression, Other Regression-Based Methods of prediction, Evaluating the Accuracy and error measures of a Classifier or Predictor.

Web Mining: Anatomy of a search engine, Crawling the web, Web Graph Analysis, Extracting structured data from the web, Classification and vertical search, Web Log Analysis.

Advanced Analysis: Mining Stream, Time-Series, and Sequence Data, Graph Mining, Social Network Analysis, and Multi-relational data mining, Mining Object, Spatial, Multimedia, and Text Data.

ECE 4244 Data Mining Contact hours/week: 3/2

Sessional based on the theory of course ECE 4243 **Credits: 0.75**

ECE 4245 Contact hours/week: 3 Neural Networks & Fuzzy Systems Credits: 3

Introductory Concept: Introduction Human Brain Mechanism, Neural Machine Intelligence.

Fundamental concept of Neural Network: Basic models of artificial neuron, activation function, network architecture, neural network viewed as directed graph, Basic learning rules, overview of perceptrons, Single layer of perceptrons, mathematical model of single layer perceptrons, perceptrons learning algorithm, Delta learning rule, Multi-layer perceptrons, Back propagation learning algorithm, mathematical model of MLP network.

Function Approximation: Basis function network, Radial Basis function networks (RBF), MLP vs. RBF networks, Support vector machine (SVM).

Competitive Network and Associative memory network: Adaptive Resonance Theory (ART), ART-1 architecture and algorithm, Kohonen Self-organizing Maps (SOMs), Linear Feed-forward Associative memory network, Recurrent associative memory network, Bidirectional Associative memory network (BAM), Hopfield networks.

Fuzzy System: Introduction to Fuzzy system, Fuzzy relations, fuzzy numbers, Linguistic description and their analytical form, fuzzy control.

Defuzzification: Defuzzification Methods, Centroid Method, Center of Sum Method, Mean of Maxima Defuzzification, Applications, Equilibrium of Learning System, Concept of Neuro-Fuzzy and Neuro-GA Network.

Genetic Algorithm: Basic Concepts, Offspring, Encoding, Reproduction, Crossover, Mutation Operator, Application of GA.

ECE 4246 Neural Networks & Fuzzy Systems Sessional Contact hours/week: 3/2

Sessional based on the theory of course ECE 4245 **Credits: 0.75**

Optional IV

ECE 4249 Digital Communication Contact hours/week: 3 Credits: 3

Introduction: Communication channels, mathematical model and characteristics. Probability and stochastic process. Source coding: Mathematical models of information, entropy, Huffman code and linear predictive coding. Digital transmission system: Base band digital transmission, inter-symbol interference, bandwidth, power efficiency, modulation and coding trade-off. Receiver for AWGN channels: Correlation demodulator and maximum likelihood receiver. Channel capacity and coding: Channel models and capacities and random selection of codes. Block codes and conventional codes: Linear block codes, convolution codes and coded modulation. Spread spectrum signals and system.

ECE 4250 Digital Communication Sessional

Contact hours/week: 3/2 Credits: 0.75, Sessional based on the theory of course ECE 4249.

ECE 4251 Antennas and Propagation

Contact hours/week: 3 Credits: 3

Fundamental of Antennas: Vector Potential Functions, Electric and Magnetic Fields for Electric and Magnetic Current Sources, Solution of Vector Potential Wave Equation.

Antenna Arrays: Two-Element Array, N-element Linear Arrays: Broad-side, End-fire, Phased, Binomial, Dolph-Tchebyscheff and Super-directive Arrays, Determination of Array Factor and Patterns, Planar and Circular Arrays. Travelling-Wave and Broad-band Antennas: Long wire, V, Rhombic and Helical Antennas, Yagi, Uda array, Frequency Independent and Log-periodic Antennas.

Aperture, Reflector and Lens Antennas: Huygens's Principle, Rectangular and Circular Apertures, Microstrip Antennas.

Babinet's Principle, Sectoral, Pyramidal and Conical Horns, Parabolic and Cassegrain Reflector Antennas, Lens Antennas.

Antenna Measurement: Antenna ranges, Radiation Pattern, Gain and Directivity, Polarization.

Radio wave propagation: Ground wave propagation, Ionospheric propagation, Propagation losses.

ECE 4252 Antennas and Propagation Sessional

Contact hours/week: 3/2 Credits: 0.75 Sessional based on the theory of course ECE 4251.

ECE 4253 Radar and Satellite Communication Contact hours/week: 3 Credits: 3

Radar: Introduction to Radar, Radar Equation CZ, Operating Principle of Radar with Block Diagram, CW and FM Radar, Tracking Radar, Antennas for Radar, Radar Receivers, Radar Transmitting System, Duplexer, Usable Frequencies for Radar, Radar Applications.

Satellite Communication: Overview of Satellite System Engineering. Spacecraft, Introduction, to Spacecraft Subsystem. (AOCS), Telemetry, Tracking and command (TT&C). Spacecraft Antennas, Basic Antenna Types and Relationships Spacecraft, Antennas in Practice, Frequency Reuse Equipment Reliability and Space Qualification, Reliability redundancy. Multiple Access. Earth station Technology : Earth Station Design, Earth Station Design for Low System Noise

Temperature, Large Earth Station Antennas. Satellite Television Broadcasting Networks, VSAT technology.

ECE 4255 Fiber Optic Communication Contact hours/week: 3 Credits: 3

Introduction : Historical perspective, basic system, nature of light, advantages and applications of fiber optic. Optics review : Ray theory and applications, lenses, imaging, numerical aperture, diffraction. Light wave fundamentals : Electro magnetic waves, Dispersion, polarization, resonant cavities, reflection at plane boundary, critical angle. Integrated optic waveguides : Slab waveguide, Modes in symmetric and asymmetric waveguide, coupling, Dispersion and distortion, Integrated optic components.

Optic fiber waveguide : Step index fiber, graded index fiber, attenuation, pulse distortion and information rate, construction of optic fiber, optic fiber cables. Light sources : LED, LD, distributed feedback LD, optical amplifiers, fiber laser, vertical cavity surface emitting laser diode. Light detectors : Photo detection, photo multiplier, semiconductor photodiode, PIN photodiode, avalanche photodiode. Couplers and connectors : Connector principle, end preparation, splices, connectors, source coupling.

Network distribution and fiber components: Directional couplers, star couplers, switches, isolator, wave-length division multiplexing, fiber bragg grating. Modulation: LED modulation, LD modulation, Analogue and digital modulation, modulation formats, optic heterodyne receivers. Noise and detection : Thermal shot and noise, SNR, error rates, receiver circuit design. System design: Analogue and digital system design, few real life problems and examples.

ECE 4257 Biomedical Engineering Contact hours/week: 3 Credits: 3

Medical terminology, cell physiology, membrane potential, action potential, Rhythmic excitation of heart.

Transducers used in medical diagnostics.

Biomedical Instrumentation: Normal Electrocardiograph, ECG simulator, Watch filter, ECG amplifier, pulse beat monitor, pace maker, galvanic skin resistance detector, respiratory and suction apparatus. Electronic stethoscope. Electronic clinical thermometer, blood flow and pressure monitoring recorders, metabolic rate measurement.

Special topics: Bio-telemetry, application of ultrasonic and laser in biology and medicine.

Clinical X- ray equipment. Fluoroscopy. Infrared heating.

ECE 4258 Biomedical Engineering Sessional Contact hours/week: 3/2 Credits: 0.75

Sessional based on the theory of course **ECE 4257**.

ECE 4259 Radio and TV Engineering Contact hours/week: 3/2 Credits: 0.75

Introduction to radio communication, History, Frequency management. Design of radio transmitter and receiver circuits using scattering-parameter methods. Circuits include oscillators, radio frequency amplifiers and matching networks, mixers and detectors. Design of amplitude, frequency, and pulse-modulated communication systems, including modulators, detectors, and the effects of noise.

Television: Introduction, principle of operation, transmitter and receiver, Receiving and transmitting antenna. Camera tube, Picture tube, Electron beam scanning, T-lines, balun, duplexer, Vestigial side-band filters. Introduction to color TV, VCR, CCTV, CATV, MATV, TV Booster.

ECE 4260 Radio and TV Engineering Sessional Contact hours/week: 3/2 Credits: 0.75

Sessional based on the theory of course **ECE 4259**.