GUJARAT TECHNOLOGICAL UNIVERSITY

AHMEDABAD

&

SEER AKADEMI PVT. LTD.

M.E (VLSI &Embedded Systems Design)

735202: RTOS, Kernels and Device Drivers

Objective:

The study of embedded systems architecture, hardware-software abstraction, resource allocation, software stacks, Real time Systems and operating systems internals.

In the process of the laboratory work it is necessary to use and study standard and emerging development kit platforms for OS development.

Lecture:

UNIT I– Introduction

Embedded System Architecture fundamentals. Hardware and Software abstraction models. Operating Systems fundamentals. Real time OS overview.

UNIT II- RTOS Fundamentals

Study of Real time OS principles and requirements. Application specific requirements. Throughput and latency requirements. Schedulers, tasks and processes. Memory management. Code and footprint optimization. Study of current and emerging RTOS.

UNIT III - OS internals and Kernels

Internal components of Operating systems. Study, compare and contrast of various OS platforms. Unix/Linux kernel fundamentals. I/O devices, file systems and peripheral devices.

UNIT IV - Device drivers

Fundamentals of device drivers, device enumeration and configuration. Data transfer and management mechanisms.

UNIT V-- Device drivers II

Wired and wireless connectivity of devices. Power Management and its impact on device management. Compliance to protocols.

Lab:

Tools used during laboratory works: Keil, Cypress PSoC, Windows Mobile, Linux, VxWorks, Symbian platforms.

 Study and implementation of RTOS

- Study and implementation of kernel modification
- Study and implementation of device driver development

Course Project:

A project of suitable complexity, comprising of program design, coding, compilation and debug must be completed.

Course Material:

The field of VLSI and Embedded Systems is getting updated constantly and to keep up to date with the latest research, technology and industry trends, Instructor for this course will decide and provide the course material. This could be a combination of slides or research material or text book references or any other relevant documentation depending on a) the nature of the curriculum and b) relevant skills to be imparted as outcome of the course.

References:

- Product documentation from ARM (KEIL), Cypress, Windows Mobile, VxWorks, Symbian.
- Bus Specifications – Bluetooth, USB, 802.11x
- Standards specifications – JPEG, MPEG etc. as required
- Instructors may recommend additional textbooks or reference material – the subject content is rapidly changing and an up to date text book at the time of the class may be recommended.

GUJARAT TECHNOLOGICAL UNIVERSITY

AHMEDABAD

&

SEER AKADEMI PVT. LTD.

M.E (VLSI &Embedded Systems Design

735203: Wireless Technology for Embedded Systems

Objective :

The main objective of the course is to enable students to understand the computing principles in emerging technologies and applications for embedded systems with special focus on wireless technologies and Wireless Sensor Networks (WSN). The course addresses tradeoff considerations of bandwidth, cost and power among the three wireless technologies - Bluetooth, WiFi and ZigBee.

Lectures :

UNIT I :

Review of C Programming, Data Structures , Introduction to UML , Software Life Cycle Models , Embedded Systems Design, Implementation and Testing , Overview of Networking and Packet Switching Concepts, OSI Reference Model and TCP/IP Protocol Suite, LAN Protocol Suite

UNIT II :

Evolution of Wireless Communication - Radio architectures: TRF, single conversion, and dual conversion, and IQ; Modulation - AM, FM, SSB, TDMA, CDMA, OFDM, QPSK; PLL – phase lock loops, Wireless Standards – IS136, IS95, 802.11(a-g), GSM, 3G, WiMax, Antennas and Propagation with an introduction to the Smith Chart

UNIT III :

Embedded Systems – Hardware, Software, Internet Access; Development and Debugging Tools - Simulators, ICE, C Compiler; RTOS – System Services, Interrupt Handling, Real Time, Scheduling; Socket Programming – Internet Architecture, UDP, TCP, client/server; Internet Application Protocols – HTTP, FTP, SNMP, Audio/Video Applications

UNIT IV :

Embedded systems hardware and software interfaces; Protocol Debugging & Testing Tools – PING, Sniffers, Load Generators; Development tools – SDK, simulators, debuggers; TCP/IP – architecture, socket programming and debugging

UNIT V :

Wireless Technologies and Mobile Programming - Wireless LAN : 802.11 & WiMAX, RFID & Bluetooth, GSM & GPRS, Mobile Development Platforms (Android, Symbian, OpenMoko, J2ME), Bluetooth –

architecture, protocols, implementation, and programming API; WiFi – architecture, protocols, implementation, and API; ZigBee – architecture, protocols, implementation, and API

Course project :

A project of reasonable complexity that is relevant to Embedded Systems Design must be completed

Course Material:

The field of VLSI and Embedded Systems is getting updated constantly and to keep up to date with the latest research, technology and industry trends, Instructor for this course will decide and provide the course material. This could be a combination of slides or research material or text book references or any other relevant documentation depending on a) the nature of the curriculum and b) relevant skills to be imparted as outcome of the course.

References :

 Embedded Systems and Wireless Technology: Theory and practical applications by Dr. Raúl Aquino santos, MSc. Arthur Edwards Block (University of Colima, Mexico)

 Fundamentals of Mobile and Pervasive Computing by Frank Adelstein, Sandeep K.S. Gupta, Golden G. Richard III, and Loren Schwiebert, Publisher: McGraw-Hill Education, 2005, ISBN-10:0071412379, ISBN-13: 978-0071412377.

 Context-Aware Pervasive Systems: Architectures for a New Breed of Applications by Seng Loke, Publisher: AUERBACH, 1st edition (December 7, 2006), ISBN-10: 0849372550, ISBN-13: 978-0849372551

 Cooperating Embedded Systems and Wireless Sensor Networks by Michel Banatre (Editor), Pedro Jose Marron (Editor), Anibal Ollero (Editor), Adam Wolisz (Editor)

GUJARAT TECHNOLOGICAL UNIVERSITY

AHMEDABAD

&

SEER AKADEMI PVT. LTD.

M.E (VLSI &Embedded Systems Design)

735204 : Crosstalk and Noise

Objective:

The main objectives of the course are to study the transmission line theory and to study crosstalk and noise basics

Lecture:

UNIT I - Introduction

High speed design. Signal representation. Rise time and circuit length. Conductive Path. The interconnect budget.

UNIT II - Transmission line theory

Ideal transmission line. Wave propagation. Transmission line parameters . Cross section of a micro strip transmission line. RLCG model. Characteristic impedance. Available two-dimensional electromagnetic field solvers. Propagation Velocity, Time, and Distance. Nonideal line losses. Transmission line losses. Skin Effect. Serpentine Traces. Simultaneous switching noise.

UNIT III -- Reflections

Impedance and Reflections. Multiple Reflections. Lattice Diagram Analysis. Effect of Rise Time on Reflection. Multiple line impedances. Reflections from a Reactive Loads. Reflections from a Reactive Loads.

UNIT IV - Crosstalk and noise

Crosstalk configuration. Mutual Inductance and Mutual capacitance. Crosstalk-Induced Noise. Simulating Crosstalk . Crosstalk-Induced Flight Time and Signal Integrity Variations. Effect of Switching Patterns on Transmission Line Performance. Odd Mode. Even mode . Crosstalk Trends. Minimization of crosstalk.

UNIT V - Clock Distribution Networks

Clock Distribution. Clock Skew. Clock Power. Clock Area. Technology Trends

Labs:

The labs will include:

- Lattice diagram analysis of transmission line system with multiple line impedance
- Dependence of crosstalk glitch from the number of segments in distributed RC line
- Dependence of settling time from the input signal slope

Course Project:

A project of suitable complexity, comprising of program design, coding, compilation and debug must be completed.

Course Material:

The field of VLSI and Embedded Systems is getting updated constantly and to keep up to date with the latest research, technology and industry trends, Instructor for this course will decide and provide the course material. This could be a combination of slides or research material or text book references or any other relevant documentation depending on a) the nature of the curriculum and b) relevant skills to be imparted as outcome of the course.

References:

- R.Singh. Signal Integrity Effects in Custom IC and ASIC Designs. J. Wiley, 2001.
- B. Young. Digital Signal Integrity. Prentice Hall, 2001.
- F. Moll, M. Roca. Interconnection Noise in VLSI Circuits. Kluwer, 2004.
- A. V. Mezhiba, E. G. Friedman. Power Distribution Networks in High Speed Integrated Circuits Kluwer, 2004.
- M. Celik, L. Pileggi, A. Odabasioglu. IC Interconnect Analysis Kluwer, 2002.
- C-K. Cheng, J. Lillis, S. Lin, N. H. Chang. Interconnect Analysis and Synthesis J. Wiley, 2000.
- J. A. Davis, J. D. Meindl. Interconnect Technology and Design for Gigascale Integration Kluwer, 2003.

GUJARAT TECHNOLOGICAL UNIVERSITY

AHMEDABAD

&

SEER AKADEMI PVT. LTD.

M.E (VLSI &Embedded Systems Design)

735205: Mobile Applications Development

Objective:

The study of embedded systems architecture, mobile system constraints and application development.

In the process of the laboratory work it is necessary to use and study standard and emerging development kits or developer suites for mobile platforms for OS development.

Lecture:

UNIT 1 – Introduction

Survey of prominent mobile platforms – smart phones, camera/camcorder devices, Tablet devices, automotive.

UNIT II

Energy/Power Management in mobile systems. Mobile OS and developer packages overview.

UNIT III – Developer environments

Study of iPhone, iPad, Windows Mobile (HTC), Android (Google, Motorola) platforms.

UNIT IV

Study of Automotive platforms.

UNIT V – Actual Application Development

This course is focused on getting the students to actually develop an application on a target mobile device. The students must download the environment, develop and demonstrate an actual application on a mobile device.

Course Project:

A project of suitable complexity, comprising of program design, coding, compilation and debug must be completed.

Course Material:

The field of VLSI and Embedded Systems is getting updated constantly and to keep up to date with the latest research, technology and industry trends, Instructor for this course will decide and provide the course material. This could be a combination of slides or research material or text book references or any other relevant

documentation depending on a) the nature of the curriculum and b) relevant skills to be imparted as outcome of the course.

References:

- iPhone/iPad developer manuals
- Android developer manual
- Standards specifications – JPEG, MPEG etc. as required
- Instructors may recommend additional textbooks or reference material – the subject content is rapidly changing and an up to date text book at the time of the class may be recommended.

GUJARAT TECHNOLOGICAL UNIVERSITY

AHMEDABAD

&

SEER AKADEMI PVT. LTD.

M.E (VLSI &Embedded Systems Design)

735206: Digital Signal Processing

Objective:

The goal of the course is to teach graduate students the concepts of digital signal processing, frequency domain representations of discrete-time signals using discrete-time Fourier transform, the discrete Fourier transform, fast Fourier transform and z-transform in a very practical manner

The main objectives of the course are:

 To study digital filter design methods.

 To learn and use the Matlab program system for investigating and designing digital filters as a part of laboratory exercise.

Lecture:

UNIT I - Signals and Signal processing

Classification of signals; Examples of typical signals; Signal applications; Causality, Stability.

Discrete time signals; The sampling process; Characterization of linear time-invariant systems; Convolution and its properties; Difference equations.

UNIT II - The Discrete Fourier Transform

The discrete-time Fourier transform; Discrete Fourier transform and its properties; Linear convolution; Fast Fourier transform; z-transform and inverse z-transform.

UNIT III - Linear Time-Invariant Discrete Systems in the Transform Domain

Finite dimensional discrete systems; Transfer function; Simple digital filters; Inverse systems; Linear phase filters; Chebyshev's theorem, Remez algorithm.

UNIT IV - Digital Processing of Continuous-Time Signals

Sampling of continuous-time signals; Paley-Wiener theorem; Nyquist frequency; Kotelnikov-Shenon's theorem; Analog low pass filter design; Design of analog high pass; Band pass and band shop filters; Analog - to - digital converter; Digital- to-Analog converter.

UNIT V - Digital Filter Structures

Block diagram representation; Basic finite and infinite impulse response (FIR & IIR); Digital filter structures; All pass filters; IIR tapped cascaded lattice structure; FIR cascaded lattice structure; Digital sine-cosine generator.

Preliminary considerations; Bilinear transformation method of IIR filter design; Design of low pass; High pass; Band pass; Band shop IIR digital filters; Spectral transformations of IIR digital filters; FIR filter design based on Windowed Fourier series; Design of FIR digital filters with least-mean-square error; Digital IIR filters design; Analog filters - Bessel, Butterworth, Chebyshev, elliptic filters.

Labs:

Matlab/Octave/Python package tools are used and applied during laboratory exercises.

Units include:

- Discrete-time IIR filter design
- Analog filter design (Butterwoth, Chebyshev, Elliptic Lowpass Filters)
- Analog-to-digital lowpass transformations
- Frequency-band transformations

Discrete-time FIR filter design

- Window design technique
- Optimal equiripple design technique for linear-phase FIR filters

Course Project:

A project of suitable complexity, comprising of program design, coding, compilation and debug must be completed.

Course Material:

The field of VLSI and Embedded Systems is getting updated constantly and to keep up to date with the latest research, technology and industry trends, Instructor for this course will decide and provide the course material. This could be a combination of slides or research material or text book references or any other relevant documentation depending on a) the nature of the curriculum and b) relevant skills to be imparted as outcome of the course.

References:

- Sanjit K. Mitra. Digital Signal Processing. 2nd edition. McGraw Hill. 2001.
- M.H. Hayes. Digital Signal Processing, Shaum's Outlines. McGraw Hill. 1999.
- V.K. Ingle. J.G. Proakis. Digital Signal Processing using Matlab. Brooks/Cole. Thomson-Engineering; 2nd edition. 2006.
- L. R. Rabiner, B. Gold. Theory and Application of Digital Signal Processing. Prentice-Hall, New Jersey, 1975

GUJARAT TECHNOLOGICAL UNIVERSITY

AHMEDABAD

&

SEER AKADEMI PVT. LTD.

M.E (VLSI &Embedded Systems Design)

735207 : Image Processing

Objective:

The study of Image processing principles and implementation in an IC or System. In the process of the laboratory work it is necessary to study the main Image processing standards, platforms and to implement algorithms either in an IC design or embedded system design.

Lecture:

UNIT I – Fundamentals of Image Processing and Image Transforms

Basic steps of Image Processing System Sampling and Quantization of an image – Basic relationship between pixels Image Transforms: 2 D- Discrete Fourier Transform, Discrete Cosine Transform Wavelet Transforms: Continuous Wavelet Transform, Discrete Wavelet Transforms.

UNIT II – Image Processing and Image Compression Techniques

Image Enhancement. Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters. Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering. Image Segmentation Segmentation concepts, Point, Line and Edge Detection, Thresholding, Region Based segmentation.

Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compression models: Lossy & Lossless, Huffman coding, Arithmetic coding, LZW coding, Run length coding, Bit plane coding, Transform coding, Predictive coding, Wavelet coding JPEG Standards.

UNIT III – Basic steps of Video Processing

Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.

UNIT IV – 2-D Motion Estimation

Optical flow, General Methodologies, Pixel Based Motion Esimation, Block- Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based ransform coding, Predictive coding, Application of motion estimation in Video coding.

UNIT V – Commercial image acquisition and projection systems

Study of OMAP, DLP, CCD and other devices in the market. 3-D TV and other emerging applications.

Lab :

Tools used during laboratory works: VCS, Design Compiler, ICC, Primetime, PrimePower, Matlab,TI or other Laboratory kits, gcc, gdb.

 Study and implementation of various algorithms and transforms.

(The implementation may be done either in VLSI domain or embedded systems domain. Student must choose a platform on which standard algorithms and transforms can be executed.)

Course Project:

A project of suitable complexity, comprising of program design, coding, compilation and debug must be completed.

Course Material:

The field of VLSI and Embedded Systems is getting updated constantly and to keep up to date with the latest research, technology and industry trends, Instructor for this course will decide and provide the course material. This could be a combination of slides or research material or text book references or any other relevant documentation depending on a) the nature of the curriculum and b) relevant skills to be imparted as outcome of the course.

References:

 TI documentation on DSP/OMAP platforms.

 Documentation manuals on DLP, 3-D TV and other projection systems

 Digital Image Processing – Gonzaleze and Woods, 3rd ed., Pearson.

 Video processing and communication – Yao Wang, Joem Ostermann and Ya–quin Zhang. 1st Ed., PH Int.

GUJARAT TECHNOLOGICAL UNIVERSITY

AHMEDABAD

&

SEER AKADEMI PVT. LTD.

M.E (VLSI &Embedded Systems Design)

735201: Technical Writing, Presentation Skills and IP.

Objective:

The main objective of the course is to teach technical and business writing, including skills for IC design documentation creation

Lecture:

UNIT I - Introduction

Fundamentals of clear and concise writing. Analysis of technical documents, manuals etc. Overview of intellectual property.

UNIT II - Comprehension and writing

Book reports – structure, protagonist, antagonist, plot, rising action and climax.

Business writing – grants, proposals, letters.

Technical documentation – definition of terms, indexing, structure and clarity elements.

UNIT III - Presentation Skills

Making concise and clear presentations.

Speaking skill, grammar and pronunciation.

Tone and eye contact.

Handling friendly and hostile audience members.

UNIT IV - Intellectual Property

Patents, copyrights and trademarks.

Process and Method patents.

IP litigation case studies.

Protecting a new venture’s intellectual property and ethical handling of intellectual property.

UNIT V-Technical Reading

Study of Data sheets, Technical Manuals, Product/Architecture Plan

Labs:

- Study and implementation of book reports
- Study and implementation of presentations

 Study and implementation of technical manuals

 Study and implementation of patents

Tool used during laboratory exercises: OpenOffice.org or MS-Office.

Course Project:

A project of suitable complexity, comprising of program design, coding, compilation and debug must be completed.

Course Material:

To keep up to date with the latest research, technology and industry trends, Instructor for this course will decide and provide the course material. This could be a combination of slides or research material or text book references or any other relevant documentation depending on a) the nature of the curriculum and b) relevant skills to be imparted as outcome of the course.

References:

 H. Solveig, J. Floyd. OpenOffice.org Resource Kit. Prentice-Hall PTR. 2003. 1040p.

 L. Gurdy, E. Finkelstein, M. Leete. OpenOffice.org for Dummies. Wiley Publishing. 2004. 361p.

 R. Whittle. Book design with Open Office. 2002.

730001: Seminar.

730002: Presentation of Literature Review.

730003: Dissertation Phase – I.

----------XoX----------