SEM VI EComE

Syllabus

Course Name: Embedded Systems [2:0:2=3]

Course Content

Introduction to AVR family of microcontroller. Architecture, pin diagram and features of ATMega16 microcontroller. Power supply and development board design. I/O, seven segment display in single and multiplexed mode. Analog to digital convertor basics and interfacing temperature, LDR etc. Interrupts basics and programming. Timers, watch-dog basics and programming. Serial communication basics and programming e.g. UART, I2C, and SPI. LCD 16x2, 16x4 basics and programming. Actuators e.g. dc, servo, stepper, and BLDC motor driver design basics and programming. EEPROM programming basics. PWM generation e.g. fast, phase correct PWM etc. Analog comparator programming. Introduction to ARM controller STM32. Input output programming. Communication protocols like I2C, SPI, CAN BUS

Course Outcomes

CO1: Able to design their own customized microcontroller based system according to requirement

CO2: Able to do microcontroller programming

CO3: Able to fabricate customized PCB

CO4: Able to solve real life problems using embedded system skills

Text Book:

1) AVR controller by Mazidi and Mazadi
2) ATMEGA 16 datasheet
3) STM32 datasheet

Course Name: Digital Signal Processing [2:0:2=3]

Course Content

Quick Review of Signals and systems with focus on discrete time aspects in time and frequency domain: Differential equation, Difference equation, Laplace domain representation of signals and systems, transfer function, z-transform, z-transform (inverse) representation of discrete time signals and systems. Continuous Fourier transform.

Analog to Digital Conversion: Sampling, Mathematical Modelling of the Sampling Process, Mathematical and Time-Frequency Diagram/Graphical Convolution Methods of Derivation of the Sampling Theorem for Low Pass Signals, Nyquist Rate of Sampling, Aliasing, Sampling Techniques: Ideal, Natural, Flat Top, Data Reconstruction: Ideal Reconstruction Filter. Digital to Analog Construction, Zero Order Hold, Low Pass Filter, Basics of DAC Sinc and its compensation.

Transition from continuous-time to Discrete-time Frequency Domain Analysis: Discrete Time Fourier Transform, Discrete Fourier Series, Discrete Fourier Transform. Relation between the Discrete Fourier Transform of a finite set of samples and the continuous Fourier transform of the original signal. Sampling in Time and Frequency domain. Relation between the DFT and Circular convolution. Different windowing functions and their basic necessity. Convolution/Deconvolution techniques using DFT and otherwise overlap-add/save. Effect of interpolation and decimation on the frequency spectrum of discrete-time signals.

Discrete Time Network Structures: Feedforward, Feedback, combination and lattice structures for implementing different transfer functions in the s- and z-domain (esp). Frequency Response and Poles and Zeros of such structures. FIR and IIR transfer functions and structures. stability criteria and assessment of relative stability.

FIR & IIR filter design: Linear Phase FIR filter design. Phase delay and Group delay concepts applied. Delay distortion in non-linear phase filters. Application of windowing functions to Filter design. Design of IIR filters from the corresponding continuous analog systems and transfer functions. Butterwort, elliptic etc filter design. All pass and minimum phase systems.

Efficient Computation of the DFT: Efficient computation of DFT via FFT algorithm. In-Place computation, bit-reversal etc. Overview of Cooley-Tuckey, Vinograd etc Algorithms. Goertzel Algorithm for computation of DFT coefficients at selected frequencies it time permits.

Basics of Spectrum Estimation: Windowed DFT averaged over several such windows of incoming signal over magnitude spectra of various windows. The reason and importance of windowing. Rectangular, triangular, Hamming, Hanning, Blackman-Harris etc. windows. PSD estimation.

Basics of effects of coefficient quantization on output of FIR/IIR Structures: Error estimation, Stability Studies, Limit Cycles etc.

Course Outcomes

CO1: Understanding the Transition from Analog to digital Domain and the process of Sampling in both T-F Domains leading to Nyquist Baseband Sampling theorem. A/D and D/A conversion in both T_F Domains, Quantisation noise, SNR before A/D and After A/D, DAC Sinc Compensation.

CO2: Understanding Frequency Domain Analysis of Discrete time Signals & Systems: DTFT, DFS, DFT, FFT, Spectrum Estimation, PSD Estimation.

CO3: Understanding Z-Domain Analysis of Z-Transform and representation and Analysis of Discrete Time Signals Systems in Z-Domain, Both FIR & IIR. Discrete Structures for representing /implementing various Hybrid Z-Domain Transfer functions. Relation betweeen Z-TRansfrom and DTFT. Frequency Domain.

CO4: Design and implementation of FIR Linear Phase Filters, IIR Filters via Impulse Invariance and Bilinear Transformation methods, All Pass Filters for Phase compensation etc.

Text Book:

1) Oppenheim & Schafer, "Discrete Time Signal Processing.", Pearso
2) Proakis & Manolakis, " Digital Signal Processing: : Principles, Algorithms, and Applications "
3) B.P. Lathi, "Principles of Signal Processing and Linear Systems", International Version - 2009, Oxford University Press.
4) Oppenheim & wilsky, "Signals & Systems"

Course Name: Digital Communication [3:0:0=3]

Course Content

Introduction to Shannon's Channel Capacity Theorem. Baseband Pulse transmission: Matched Filter. Error rate due to Noise. ISI. Nyquist's Criterion for Distortion-less Baseband Pulse transmission. Correlative Level Coding, Partial Response Signalling. Baseband M-ary PAM, PCM. Optimum Linear Rx. Adaptive Equalization/Channel estimation PSTN/ADSL/4G etc. Signal Space Analysis: Geometric Representation of signals. Conversions of Continuous AWGN Channel into discrete Vector Channel model. Likelihood functions. Coherent detection in presence of noise, MLD. Correlation Rx. Probability of Error. Passband Digital Transmission: Coherent BPSK, QPSK, M-ary PSK. QAM. FSK, MSK, GMSK for GSM. NC-OM, NC-FSK. CAP. Orthogonal Modulation – OFDM/DMT in 4G/ADSL. Multiuser Radio Communication: Basic Sat-Com. Radio Link analysis. Wireless Comm. Multipath Channels and Raleigh Fading. BER curves over fading channels for different modulation schemes. Importance of diversity in time, space (SIMO,MISO, MIMO etc). Multiple Access Technologies like TDMA, CDMA, OFDMA, SCDMA etc. Introduction to Information theory: Information to the concept of Discrete data Information, entropy etc. Basics of Data Compression, Source coding theorem. Huffman coding, Lempel-Ziv Algorithm. Discrete Memoryless channel, with AWGN. Mutual Information. More Information Theory and Error control coding: Channel coding theorem, Differential Entropy and Mutual information of continuous ensembles. Information capacity theorem. Linear Block codes. Discrete Memory-less Channel in detail. Cyclic codes. Convolution codes. MLSE of Convolution codes & Viterbi Algorithm. TCM. Basic Introduction to turbo codes & LDPC.

Course Outcomes

CO1: Understanding the concept Noise Immunity in Digital communication and various blocks and their functions in the Block Diagram of a digital Communication Systems.

CO2: Understanding Base-Band Communication, Matched Filter, Best Decision Making at RX, ISI, The MMSE Optimum Rx in presence of both Signal and Noise, Adaptive Filtering via LMS for Converging to the MMSE Optimum Solution, Adptive Equalisation and Channel Estimation via LMS.

CO3: Basic Modulation/demodulation schemes like ASK, BPSK, QPSK, FSK, QAM and M-ary versions explained and learnt in Signal Space Analysis. Learn OFDM with Special Focus as it forms the core of ADSL, WiFi, WiMAX, LTE, and even ultr-modern optical communication.

CO4: Understanding MLSE and MAP Detection rules at the Receiver to minimise BER & SER, Gray Coding and the relation between the Two. Basics of Convolutional Coding/Decoding & intro to Turbo coding and Viterbi algorithm for Decoding Convolutional codes.

Textbook:

1) Simon Haykin, ―Digital Communication Systems‖, John Wiley & sons, First Edition, 2014, ISBN 978-0-471-64735-5.

2) John G Proakis and Masoud Salehi, ―Fundamentals of Communication Systems‖, 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.