KANNUR UNIVERSITY

Faculty of Engineering

Curriculum, Scheme of Examinations and Syllabi for M-Tech Degree Programme with effect from Academic Year 2011-2012

ELECTRONICS & COMMUNICATION ENGINEERING

M Tech

in

COMMUNICATION ENGINEERING & SIGNAL PROCESSING

FIRST SEMESTER

Code	Subject	Hours/Week			Sessional Marks	University Examination		Credit
		L	T	P		Hrs	Marks	
CSP 101	Linear Algebra for Signal processing	3	-	-	50	3	100	3
CSP 102	Random Processes & Applications	3	-	-	50	3	100	3
CSP 103	Advanced Digital Communication	3	-	-	50	3	100	3
CSP 104	DSP Processor & Architecture	3	-	-	50	3	100	3
CSP 105	Elective I	3	-	-	50	3	100	3
CSP 106	Elective II	3	-	-	50	3	100	3
CSP 107(P)	Advanced Communication Engineering Lab	-	-	2	50	3	100	2
CSP 108(P)	Seminar	-	-	2	50	-	-	2
TOTAL		**18**		**4**	**400**		**700**	**22**

ELECTIVE-I

CSP 105 (A) VLSI Structures for Digital Signal Processing
CSP 105 (B) Digital Filter Design & Applications
CSP 105 (C) Radio Frequency Integrated Circuits
CSP 105 (D) Wireless Communication I

ELECTIVE II

CSP 106 (A) Electromagnetic Compatibility
CSP 106 (B) Design of Embedded Systems
CSP 106 (C) Biomedical Signal Processing & Systems
CSP 106 (D) Data Communication Systems

Sessional marks for all the Theory based Subjects

The marks allotted for internal continuous assessment and end-semester university examinations shall be 50 marks and 100 marks respectively with a maximum of 150 marks for each theory subject.

The weightage to award internal assessment marks should be as follows:

Test papers (two tests) : 25 marks

Assignments and/or class performance : 25 marks

SECOND SEMESTER

Code	Subject	Hours/Week			Sessional Marks	University Examination		Credit
		L	T	P		Hrs	Marks	
CSP 201	Digital Image Processing	3	-	-	50	3	100	3
CSP 202	Estimation and Detection Theory	3	-	-	50	3	100	3
CSP 203	Coding Theory	3	-	-	50	3	100	3
CSP 204	Elective III	3	-	-	50	3	100	3
CSP 205	Elective IV	3	-	-	50	3	100	3
CSP 206	Elective V	3	-	-	50	3	100	3
CSP 207(P)	VLSI & Embedded Systems Lab	-	-	2	50	3	100	2
CSP 208(P)	Term Paper	-	-	2	50	-	-	2
TOTAL		**18**		**4**	**400**		**700**	**22**

ELECTIVE-III

CSP 204 (A) Statistical Signal Processing
CSP 204 (B) Optical Signal processing
CSP 204 (C) Multi rate Systems & Filter banks
CSP 204 (D) Fiber-Optic Communication
CSP 204 (E) Finite Fields and Their Applications

ELECTIVE-IV

CSP 205 (A) Spectral Analysis
CSP 205 (B) Speech Signal Processing
CSP 205 (C) Communication Networks
CSP 205 (D) Information Hiding & Data Encryption
CSP 205 (E) Fourier and Wavelet analysis

ELECTIVE-V

CSP 206 (A) Optimization Techniques
CSP 206 (B) Array Signal Processing
CSP 206 (C) Research Methodology
CSP 206 (D) Wireless Communication II
CSP 206 (E) Number theory and Cryptography

THIRD SEMESTER

Code	Subject	Hrs / Week			Marks					Credits
		L	T	P	Internal		University		Total	
					Guide	Evaluation Committee	Thesis	Viva		
PED 301(P)	Thesis Preliminary			22	200	200	--	--	400	8
	Total			**22**	**200**	**200**			**400**	**8**

THESIS PRELIMINARY

This shall comprise of two seminars and submission of an interim thesis report. This report shall be evaluated by the evaluation committee. The fourth semester Thesis- Final shall be an extension of this work in the same area. The first seminar would highlight the topic, objectives, methodology and expected results. The first seminar shall be conducted in the first half of this semester. The second seminar is presentation of the interim thesis report of the work completed and scope of the work which is to be accomplished in the fourth semester.

FOURTH SEMESTER

Code	Subject	Hrs / Week			Marks					Credits
		L	T	P	Internal		University		Total	
					Guide	Evaluation Committee	Thesis	Viva		
PED 401(P)	Thesis			22	200	200	100	100	600	12
	Total			**22**	**200**	**200**	**100**	**100**	**600**	**12**

Towards the middle of the semester there shall be a pre submission seminar to assess the quality and quantum of the work by the evaluation committee. This shall consist of a brief presentation of Third semester interim thesis report and the work done during the fourth semester. The comments of the examiners should be incorporated in the work and at least one technical paper is to be prepared for possible publication in journals / conferences. The final evaluation of the thesis shall be an external evaluation.

CSP 101 - LINEAR ALGEBRA FOR SIGNAL PROCESSING

3 hours lecture per week

Objective: *To impart the necessary mathematical skills to aid the analytical capabilities of the students*

Algebraic Structures: - Sets, Functions, Cardinality of sets, Groups, Rings, Fields, Vector spaces, Subspaces, Basis and dimension, Finite and infinite dimensional vector spaces.

Linear transformations: Linear Transformations, Sum, product and inverse of Linear Transformations, Rank-nullity theorem, Isomorphism, Matrix representation of Linear Transformations, Four fundamental subspaces of Linear Transformations, Change of bases, Linear functional.

Metric space and Hilbert space : Metric space, Open sets, Closed sets, Neighborhoods, Sequences , Convergence, Completeness, Continuous mappings, Normed space, Banach space, L^p space and l^p space, Inner product space, Hilbert space, Signal space, Properties of inner product space, Orthogonal compliments and direct sums, Orthonormal sets, Gramm-Schmidt orthonormalization process, Projections.

Matrix Theory –Matrix rank, Solving linear system of equations using matrices, LDU factorisation, QR decomposition, Least square approach, Eigen values, Eigen vectors and spectrum, Diagonalizability, Orthogonal diagonilization, Properties of Eigen values and Eigen vectors of Hermitian matrices, Normal matrices, Unitary matrices, Multiresolution analysis and wavelets.

Reference

1. Hoffman Kenneth and Kunze Ray, *Linear Algebra*, Prentice Hall of India
2. Erwin Kreyzig, *Introductory Functional Analysis with Applications*, John Wiley, 2006.
3. G.F.Simmons, *Topology and Modern Analysis* , McGraw Hill
4. Frazier, Michael W. *An Introduction to Wavelets through Linear Algebra*, Springer Publications.
5. Strang G, *Linear Algebra and its Applications*, 3rd edition, Saunders, 1988.
6. Jin Ho Kwak & Sungpyo Hong, *Linear Algebra*, Springer International, 2004

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 102 - RANDOM PROCESSES AND APPLICATIONS

3 hours lecture per week

Objective: *To develop understanding about random processes and applications*

Review of Set Theory: Set operations, functions, countable and uncountable sets

Probability space: Random experiment, Sample space, Sigma algebra, Event space, Measure, Probability measure, Borel sigma field

Random Variables and their distribution :- Probability Distribution Function, CDF, PDF and PMF. Jointly distributed Random Variables - Joint cdf, joint pdf, conditional distribution and expectation. **Expectation**: Fundamental Theorem of expectation, moments, characteristic function, correlation and covariance

Random Vector: - Definition, Joint statistics, Covariance and correlation matrix , Gaussian random vectors.

Convergence: - Markov and Chebyshev inequalities, Convergence of sequences of random variabes- almost sure convergence, convergence in probability, convergence in mean square, Weak law of large numbers, Random sums, Borel Cantelli lemma, strong law of large numbers, Central Limit Theorem for sequences of independent random variables.

Random process:- Definition of Random process, IID process, Poisson counting process, Markov process, birth-death process, Wiener process. Stationarity, Correlation functions of random processes in linear systems, power spectral density.

Discrete Time Markov Chains: conditional independence, DTMC, Recurrence analysis, Foster's Theorem, Chapman-Kolmogov theorem, Stopping time, classification of states: absorbing, recurrent, transient. Communicating classes, Continous time markov chains, Poisson process, simple Markovian queues.

Reference : -

1. B. Hajek, *An Exploration of Random Processes for Engineers*, 2005
2. D.P. Bertsekas and J. N. Tsitsiklis, *Introduction to Probability*, 2000.
3. Gray, R. M. and Davisson L. D., *An Introduction to Statistical Signal Processing.* Cambridge University Press, 2004
4. Stark Henry, *Probability and Random Processes With Application to Signal Processing*, 3/e, Pearson Education India
5. Steven Kay, *Intuitive probability and random processes using matlab*, Springer, 2006

Reading : -

1. Dr. Kishor S. Trivedi. *Probability and Statistics with Reliability, Queuing, and Computer Science Applications*, John Wiley and Sons, New York, 2001.
2. Kingsbury N. *Random Processes* [Connexions Web site]. January 22, 2004. Available at: http://cnx.rice.edu/content/col10204/1.3/
3. Athanasios Papoulis and S. Unnikrishna Pillai. *Probability, Random Variables and Stochastic Processes*, TMH

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 103 - ADVANCED DIGITAL COMMUNICATION

3 hours lecture per week

Objective: *To develop understanding about digital communication techniques*

Overview of Digital Communication: Digital communication system model. Communication channels characteristics and Models. Signal space representations. Digital modulation techniques and their performance in AWGN channels.

Communication through Band-Limited Linear Filter Channels: Optimum receiver structures for AWGN channel. Signal design for bandlimited and power limited channels, power and bandwidth efficiency tradeoff. Coding and coded modulation techniques.-capacity approaching schemes; ISI and equalization-Linear equalization, Decision feedback equalization, Turbo equalization, Self recovering equalization.

Multichannel and Multicarrier Systems: Spread Spectrum Signals-Model of Spread spectrum system. Direct sequence spread spectrum signals. Frequency -Hopped spread spectrum signals. Synchronization of spread spectrum signals.

Digital Communications through Fading Multipath Channels: Characterization and model. Frequency-Non selective, slowly fading channel, Diversity techniques. Digital signaling over a frequency-selective, slowly fading channel. Coded waveforms for fading channels.

Multiuser Communications: Multiple access techniques. Capacity of multiple access methods. CDMA. Random access methods.

Reference

1. S. Haykin, *Digital Communication,*Wiley 1999
2. John G.Proakis, *Digital Communications*, 4/e, McGraw-Hill 2000
3. S. Benedetto and E. Biglieri, *Principles of Digital Transmission with Wireless Applications*, Kluwer Academic/Plenum Publishers, 1999.

Reading

1. Viterbi, A. J. and J. K. Omura. *Principles of Digital Communication and Coding.* NY: McGraw-Hill, 1979.
2. Marvin K Simon, Sami M Hinedi, William C Lindsey - *Digital Communication Techniques –Signal Design & Detection*, PHI
3. MIT OpenCourseWare, Electrical Engineering and Computer Science,Principles of Digital Communication II, Spring 2006
4. Aazhang B. *Digital Communication Systems* [Connexions Web site]. January 22, 2004. available at: http://cnx.rice.edu/content/col10134/1.3/

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 104 - DSP PROCESSOR AND ARCHITECTURE

3 hours lecture per week

Objective: *To develop understanding about digital signal processors*

(The course requires project based on current literature in place assignment)

Review of Pipelined RISC Architecture and Instruction Set Design.

Performance and Benchmarks - SPEC CPU 2000, EEMBC DSP benchmarks.

Basic Pipeline: Implementation Details - Pipeline Hazards (based on MIPS 4000 arch).

Instruction Level Parallelism (ILP) - Concepts, Dynamic Scheduling – Tomasulo's algorithm- Reducing Data hazards. Dynamic Hardware Prediction - Reducing Branch Hazards. Multiple Issue- Hardware-based Speculation. Limitations of ILP.

Review of Memory Hierarchy - Cache design, Cache Performance Issues & Improving Techniques.

Computer arithmetic- Signed Digit Numbers(SD) - Multiplier Adder Graph - Logarithmic and Residue Number System(LNS, RNS) - Index Multiplier –Architecture for Pipelined Adder, Modulo Adder & Distributed Arithmetic(DA), CORDIC Algorithm and architecture

Case studies - Introduction to TMS 320 C 6X Processor – Architecture – Functional units - pipelining –Registers –Linear and Circular addressing modes –Types of instructions – sample program, Overview of BlackFin processor

Reference : -

1. J. L. Hennesy and D. A. Patterson, *Computer Architecture A Quantitative Approach,* 3/e, Elsivier India, Chapter 1, Appendix A, Chapter 3, Chapter 5
2. U. Mayer-Baese, Digital Signal Processing with FPGAs, Springer, 2001
3. Rulph Chassaing, Digital signal Processing and Applications with the C6713 and C6416 DSK – Wiley Interscience

Reading : -

1. *Blackfin Processor Hardware Reference, Analog Devices, Version 3.0,* 2004 (Section 2.3-2.53, 4.7-4.15, 6.1 -6.53)
2. D. Venkat Remani and M. Bhaskar, *Digital Signal Processor: Architecture Programming and Applications,* Tata Mc GrawHill, 2002
3. Phil Lapsley, J. Bier, Amit Sohan and Edward A. Lee, *DSP Processor fundamentals : Architecture and Features.* Wiley IEEE Press.
4. Sen M. Kuo, Woon-seng S. Gan, *Digital Signal Processors,* Prentice Hall.
5. Processor Manuals.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 105 (A)-VLSI STRUCTURES FOR DIGITAL SIGNAL PROCESSING

3 hours lecture per week

Objective: *To develop understanding about VLSI structures for DSP*

(The course requires project based on current literature in place assignment)

Pipelining of FIR digital filters – parallel processing for FIR systems – combined pipelining and parallel processing of FIR filters for low power – Pipelining in IIR filters – parallel processing for IIR filters – combined pipelining and parallel processing of FIR filters.

Parallel FIR filters – discrete time cosine transform – implementation of DCT based on algorithm – architecture transformations – parallel architectures for rank order filters.

Scaling and round off noise – round off noise in pipelined IIR filters – round off noise in lattice filters – pipelining of lattice IIR digital filters – low power CMOS lattice IIR filters.

Evolution of programmable DSP processors – DSP processors for mobile and wireless communications – processors for multimedia signal processing – FPGA implementation of DSP processors.

Reference:

1. Keshab K. Parhi, *VLSI Digital signal processing Systems:Design and Implementation*, John Wiley & Sons, 1999.

Reading:

2. U.Meyer-Baese, *DSP with Field programmable gate arrays*,Springer,2/E

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 105(B) - DIGITAL FILTER DESIGN AND APPLICATIONS

3 hours lecture per week

Objective: To develop skills for design of digital filters. (The course requires project based on current literature in place assignment)

LTI Systems & Transform : LTI systems as frequency selective filters. Invertibility of LTI systems. Minimum phase, maximum phase and mixed phase systems. All-pass filters. Design of digital filters by placement of poles and zeros. DFT as a linear transformation. Linear filtering methods based on DFT. Frequency analysis of signals using DFT. Discrete cosine transform.

Design of FIR filters : Introduction-Specifications-Coefficient calculation methods-Window, Optimal and Frequency sampling methods- Comparison of different methods-Realization structures-Finite word length effects-Implementation techniques-Application examples. FIR filter design with Matlab or Octave. Implementation of FIR filtering in general purpose digital signal processors.

Design of IIR filter : Introduction-Specifications. Coefficient calculation methods-Pole zero placement, Impulse invariant, Matched Z transform and Bilinear Z transform(BZT) .Design using BZT and classical analog filters. IIR filter coefficients by mapping S plane poles and zeros. Realization structures-Finite word length effects-Implementation techniques. Application examples. IIR filter design with Matlab or Octave. Implementation of IIR filtering in general purpose digital signal processors.

Adaptive Digital Filters : Concepts -Wiener filter-LMS adaptive algorithm-Recursive least squares algorithm-Lattice Ladder filters. Application of Adaptive filters.

Power Spectrum Estimation : Estimation of spectra from finite-duration signals. Nonparametric and Parametric methods for Power Spectrum Estimation.

Reference:

1. Emmanuel C. Ifeachor and Barrie W. Jervis, *Digital Signal Processing, A practical Approach,* 2/e, Pearson Education.
2. J. G. Proakis and D. G. Manolakis, *Digital Signal Processing: Principles, Algorithms, and Applications*, 4/e, Pearson Education.
3. Johnny R. Johnson, *Introduction to Digital Signal Processing,* PHI, 1992
4. Ashok Ambardar, *Digital Signal Processing: A Modern Introduction,* Thomson, IE, 2007

Reading:

1. Douglas F. Elliott, *Handbook of Digital Signal Processing- Engineering Application,* Academic Press.
2. Robert J. Schilling, Sandra L. Harris, *Fundamentals of Digital Signal Processing using MATLAB,*Thomson,2005
3. Ingle, J. G. Proakis, *Digital Signal Processing Using MATLAB,* Thomson, 1/e
4. Jones D. *Digital Filter Design* [Connexions Web site]. June 9, 2005. Available at: http://cnx.rice.edu/content/col10285/1.1/

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 105 (C) - RADIO FREQUENCY INTEGRATED CIRCUITS

3 hours lecture per week

Objective: *To develop understanding of radio frequency integrated circuits*

Introduction to wireless systems,personal communication systems,high frequency effects in circuits and systems.Review of transmission line theory,terminated transmission lines,Smith chart, impedance matching,microstrip and coplanar waveguide implementations, microwave network analysis, ABCD parameters, S parameters.

Behaviour of passive IC components and networks, series and parallel RLC circuits, resonant structures using distributed transmission lines, components and interconnects at high frequencies.

Basics of high frequencynamplifier design, device technologies, biasing techniques , simultaneous tuning of 2 port circuits, noise and distortion.

Feedback systems, phase locked loops, LNA design, designs based on impedance match noise performance, linearity, noise and large signal performance

Power Amplifier design-Various classes of power amplifiers, oscillators, linear oscillators, tuned oscillators, negative resistance oscillator system aspects in wireless trans-receiver design.

MEMS technologies and components for RF applications: RF MEMS switches, varactors, inductors and filters

Introduction to microwave antennas, definitions and basic principles

References:

1. D. M. Pozar, *Microwave and RF wireless Systems.*
2. T. H. Lee, *The design of CMOS Radio Frequency Integrated Circuits.*
3. V. K. Varadan, K. J. Vinoy, K. A. Jose., *RF MEMS and their Applications.*

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 105 (D) - WIRELESS COMMUNICATION I

3 hours lecture per week

Objective: *To develop solid knowledge on wireless communication*

(The course requires project based on current literature in place assignment)

Overview of wireless communication systems—Current wireless systems in details ;

Wireless spectrum-standards; Wireless Channels—properties, models and challenges ;

Statistical Multipath Channels— Time varying channel impulse response, Narrowband fading models, Wideband fading Models; Capacity of wireless channels—in AWGN, Fading Channels, CSI, Outage probability; Digital modulation and detection; Multicarrier Modulation—OFDM-discrete implementation, CP,ZP, channel estimation methods, Frequency and timing offset, PAPR reduction ; channel estimation and equalization—techniques and analysis of Linear, non-linear and adaptive equalization

References:

1. D. Tse and P. Viswanath, *Fundamental of Wireless Communication*, Cambridge Universities Press , 2005
2. Andrea Goldsmith, *Wireless Communications*, Cambridge University press.
3. Andreas F Molisch,Wireless Communication, Wiley
4. Simon Haykin and Michael Moher, *Modern Wireless Communications*, Pearson Education.
5. T.S. Rappaport, *Wireless Communication, Principles & Practice*,
6. G.L Stuber, *Principles of Mobile Communications*, 2/e, KluwerAcademic Publishers.
7. Kamilo Feher, *Wireless digital communication*, PHI.
8. R. L. Peterson, R.E. Ziemer and David E. Borth, *Introduction to Spread Spectrum Communication*, Pearson Education.
9. A. J. Viterbi, *CDMA Principles of Spread Spectrum*, Addison Wesley, 1995.
10. S. Verdu, *Multiuser detection*, Cambridge Univ. Press , 1998.
11. J. S. Lee and L E Miller, *CDMA Systems Engineering Handbook*, Artech House, 1998.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 106(A) - ELECTROMAGNETIC COMPATIBILITY

3 hours lecture per week

Objective: *To impart knowledge on electromagnetic compatibility*

Designing for Electromagnetic Compatibility, EMC Regulation, Typical Noise Path, Methods of Noise Coupling, Miscellaneous Noise Sources, Methods of Eliminating Interference, Noise pick-up modes and reduction techniques for analog circuits.

Cabling-Capacitive Coupling, Effect of Shield on Capacitive Coupling, Mutual Inductance Calculations, Effect of shield on magnetic coupling, Magnetic Coupling Between Shield and inner Coductor, Shielding to prevent Magnetic radiation, Shield Transfer Impedence, Coaxial cable versus shielded twisted pair, Ribbon cables

Grounding-Safety Grounds, Signal Grounds, Single point ground systems, Multipoint Ground Systems, Hybrid Grounds, Single Ground Reference for a Circuit, Ground loops, Common mode Choke.

Filtering-Power Supply Decoupling, Decoupling Filters, Amplifier Decoupling, Driving Capacitive Loads

Shielding-Shielding Effectiveness, Absorption Loss, Reflection Loss, Shielding with Magnetic Material, Shielding of electronic equipment, Use of co-axial cables and shielding of signal lines.

Digital Circuit Noise and Layout-Analog Versus Digital Circuits, Digital Logic Noise, Digital circuit Ground Noise, Power Distribution, Unused Inputs.

EMC in the design of digital circuits-Power supply and ground line distribution in digital circuits, Cross talk and reflection issues in Digital circuits, Susceptibility aspects of power electronic and digital equipment, PCB design for signal integrity, EMC standards and test equipment.

Reference Books :

1. Henry W Ott -*Noise Reduction Techniques in Electronic Systems, 2nd Edition* -, John Wiley and Sons, 1988.
2. Willium B Greason-*Electrostatic Damage in Electronics Devices and Systems* -, John Wiley and Sons, 1986.
3. Joseph Di Giacomo-*Digital Bus Hand Book* -, McGraw-Hill Publishing Company, 1990.
4. Clayton.R.Paul-*Introduction to Electromagnetic Compatibility*-Johan Wiley and Sons, 1991

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 106(B) -DESIGN OF EMBEDDED SYSTEMS

3 hours lecture per week

Objective: *To develop design skills for developing embedded systems*

Trends in Embedded System Architecture-Microcontroller based embedded system with a case study of a state or art platform (eg.ARM9)- Embedded system architecture around a DSP core with a case study of a state of art DSP controller (Eg. TMS320F2812) – FPGA based embedded system - System On Chip Assembly language programming for a state of art embedded platform (Eg.ARM9) – Review of operating system (OS) design principles - Real Time OS - Real Time Kernel - Introduction to system calls and task scheduling on a typical RTOS (Eg. uCLinux , QNX , VxWorks).

Embedded system development environment with Real time Debugging - Case study for a state of art development platform . embedded system design life cycle - introduction to RTUML

Reference:

1. Wayne Wolf, *Computers as Components: Principles of Embedded Computing System Design*, Morgan Kaufman Publishers, 2002.

Reading

Microcontroller based embedded systems:

1. M. Schlett, *"Trends in embedded-microprocessor design,"* IEEE Computer, vol. 31, no. 8, pp. 44-49, Aug. 1998.

2. M. F. Jacome and G. De Veciana, *"Design challenges for new application specific processors,"* IEEE Design & Test of Computers, vol. 17, no. 2, pp. 40-50, 2000.

3. M. R. Guthaus, J. S. Ringenberg, D. Ernst, T. M. Austin, T. Mudge, R. B. Brown, *"MiBench: A free, commercially representative embedded benchmark suite,"* IEEE 4th Annual Workshop on Workload Characterization, December 2001. Available at: http://www.eecs.umich.edu/mibench/

4. S. Segars, *"The ARM9 family-high performance microprocessors for embedded applications,"* IEEE International Conference on Computer Design, pp. 230-235, 1998.

5. P. G. Paulin, C. Liem, C, M. Cornero, F. Nacabal, and G. Goossens, *"Embedded software in real-time signal processing systems: application and architecture trends,"* Proceedings of the IEEE, vol. 85, no. 3, pp. 419-435, Mar. 1997.

Digital Signal Processors:

6. J. Eyre and J. Bier, *"The evolution of DSP processors,"* IEEE Signal Processing Magazine, vol. 7, no. 2, pp. 46-51, 2000.

7. A. Gatherer, T. Stetzler, M. McMahan, and E. Auslander, *"DSP-based architectures for mobile communications: past, present and future,"* IEEE Communications Magazine, vol 38, no. 1, pp. 84-90, Jan. 2000.

8. N. Seshan, *"High VelociTI processing [Texas Instruments VLIW DSP architecture]"*, IEEESignal Processing Magazine, v. 15, no. 2, pp. 86-101, 117, 1998.

Embedded Operating Systems:

9. L. F. Friedrich, J. Stankovic, M. Humphrey, M. Marley, and J. Haskins, Jr.; *A survey of configurable, component-based operating systems for embedded applications*, IEEE Micro, vol. 21, no. 3, pp. 54-68, May/Jun 2001.

10. V. J. Moone and D. M. Blough, *"A hardware-software real-time operating system framework for SoCs, IEEE Design & Test of Computers,* vol. 19, no. 6, pp. 44-51, Nov/Dec 2002.

11. L. Gauthier,Y. Sungjoo Yoo, and A. A. Jerraya, *"Automatic generation and targeting of application-specific operating systems and embedded systems software,"*

IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems,vol. 20, no. 11, pp. 1293-1301, Nov. 2001.
12. T. K. Tan, and A. Raghunathan, and N. K.Jha, *"Embedded operating system energy analysis and macro-modeling,"* IEEE International Conference on Computer Design, pp. 515-522, 2002.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 106 (C) - BIOMEDICAL SIGNAL PROCESSING AND SYSTEMS

3 hours lecture per week

Objective: *To develop understanding about biomedical signal processing*

Introduction to bio signals- generation of bio signals-action potential, resting membrane potential, ECG-data acquisition, lead system, arrhythmias; EEG signals and characteristics, evoked potential

Computerized data acquisition system - basic requirements, Preprocessing of biosignals-removal of interferences due to power line & Electro Surgical Unit, Adaptive filtering-fetal heart rate monitoring -a case study

Statistical Signal Processing - Introduction to random signals and its characteristics, properties of random signals, moments of signal, Concepts of PDF, autocorrelation, cross correlation, covariance, estimation of power spectral density-parametric& non-parametric, Wiener filter, implementation of algorithm for autocorrelation and PSD using MATLAB.

Analysis of bio signals – ECG- continuous monitoring, arrhythmia detection- algorithms and methods, HRV signal. EEG- video EEG, analysis of epilepsy using EEG

Prediction- Modeling of bio signals –linear models- AR model, MA model and ARMA model, Modeling of ECG signal using MATLAB

Non stationary signal analysis: Time domain methods, frequency domain methods, time-frequency methods, wavelets

Classification - introduction to ANN and Fuzzy logic, algorithm for Arrhythmia classification

Introduction to nonlinear analysis of bio signals-chaos, Analysis of heart rate variability and blood pressure variability using measures based on chaotic theory.

References:

1. Willis J. Tompkins**,** *Biomedical Digital Signal Processing* , Prentice Hall of India publications/ Eastern Economy Edition, 2nd Print, 2000.
2. Petre Stoica and Randolph Moses , Spectral Analysis of Signals, Prentice Hall, 2005.
3. D. C. Reddy, *Biomedical Signal Processing Principles and Techniques* , Tata McGraw-Hill, 2005.
4. Rangaraj M. Rangayyan , *Biomedical Signal Analysis - A case study approach* , John Wiley, 2002.
5. A. Cohen, *Biomedical Signal Processing* Vol. I & II, CRC Press, 2002.
6. *M.Akay, Detection and estimation of biomedical signals,* Academic Press, SanDiego, 1996
7. *John L Semmlow, Biosignal and Biomedical Image Processing: MATLAB-Based Applications*, Dekker/CRC Press, 2004.
8. *W. J, Tompkins, Biomedical Digital Signal Processing: C Language Examples and Laboratory Experiments for the IBM PC*, Prentice Hall, NJ:USA, 1993
9. M. Akay, *Biomedical Signal Processing,* Academic Press, San Diego, 1994.
10. Rolf Weitkunat, *Digital Biosignal Processing,* Elsevier Science, 1991
11. Eugene N. Bruce, *Biomedical Signal Processing and Signal Modeling* , Wiley-Interscience; 1 edition, 2000
12. Suresh R. Devasahayam, *Signals and System in Biomedical Engineering: Signal Processing and Physiological Systems Modeling* (Topics in Biomedical

Engineering International Book Series), Kluwer Academic/Plenum Publishers, 2000

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 106 (D) - DATA COMMUNICATION SYSTEMS

3 hours lecture per week

Objective: *To develop understanding about data communication techniques*

Data waveforms, Spectra of signals; Modes of data transmission.

Channels for data transmission, Characteristics of channels used for data transmission

Baseband Transmission, Data transmission performance – BER, BKR, phase jitters, eye diagram.

Modulated transmission: ASK, PSK, FSK and their variants. Analysis and comparison of modulation schemes.

Synchronization in data communications

ATM networks, MODEM standards

Data ,Voice integration in Internet

Principles of ISDN, ISDN standards, voice and data communication in ISDN

References:

1. Bennet and Davey, *Data Transmission*, McGraw Hill, 1965
2. John A. C. Bingham, *The theory and Practice of Modem Design*, John Wiley and Sons,1988
3. W. Stallings, *ISDN and Broadband ISDN with frame relay and ATM*, Prentice Hall,1996
4. Selected Internet RFCs (Request for Comments), available at http:/www.ietf.org/rfc.html

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 107 (P) ADVANCED COMMUNICATION ENGINEERING LAB

(2 hours practical per week)

Numerical Computing Environments – GNU Octave or MATLAB or any other equivalent tool

1. Implementation of digital modulation schemes – BASK, BFSK, BPSK. Plot BER vs Eb / N0. in AWGN channels.
2. Performance comparison of QPSK, DPSK, MSK & GMSK.
3. Communication over fading channels – Rayleigh fading & Rician fading channels.
4. Comparison of diversity combining techniques – SC, EGC & MRC.
5. Simulation of CDMA systems.
6. Implementation of Matched filter, Correlation receiver & Equalizer.
7. Gram Schmidt Orthogonalization of waveforms.
8. Carrier recovery and bit synchronization.
9. Implementation of multicarrier communication.
10. Plotting Eye pattern.
11. Constellation diagram of various digital modulation schemes.
12. Miniproject: Miniproject in the area of advanced communication/signal processing

Sessional work assessment
Regularity – 5 marks
Class work, Lab Record, Mini project Report, viva– 30 marks
Test – 15 marks
Total: Internal continuous assessment: 50 marks

University evaluation

Examination will be for 100 marks of which 70 marks are allotted for writing the procedure/formulae/sample calculation details, preparing the circuit diagram/algorithm/flow chart, conduct of experiment, tabulation, plotting of required graphs, results, inference etc., as per the requirement of the lab experiments, 20 marks for the viva-voce and 10 marks for the lab record.

Note: Duly certified lab record must be submitted at the time of examination

CSP 108 (P) – SEMINAR

(2 hours per week)

The student shall prepare a Paper and present a Seminar on any current topic related to the branch of specialization under the guidance of a staff member. The student will undertake a detailed study based on current published papers, journals, books on the chosen subject and submit seminar report at the end of the semester. The student shall submit typed copy of the paper to the Department. Grades will be awarded on the basis of contents of the paper and the presentation. A common format in (.pdf format) shall be given for reports of Seminar and Project. All reports of Seminar and Project submitted by students shall be in this given format.

Sessional work assessment
Presentation : 25
Report : 25
Total marks : 50

CSP 201 - DIGITAL IMAGE PROCESSING

3 hours lecture per week

Objective: *To develop understanding about digital image processing*

Image representation - Gray scale and colour Images, Representation of 2D signals, image sampling, quantization and reconstruction

Two dimensional orthogonal transforms -Digital images, Human visual perception,transforms: DFT, FFT, WHT, Haar transform, KLT, DCT.

Image enhancement - filters in spatial and frequency domains, histogram-based processing, homomorphic filtering.

Edge detection - non parametric and model based approaches, LOG filters, localization problem.

Image Restoration - PSF, circulant and block - circulant matrices, deconvolution, restoration using inverse filtering, Wiener filtering and maximum entropy-based methods.

Mathematical morphology - binary morphology, dilation, erosion, opening and closing, duality relations, gray scale morphology, applications such as hit-and-miss transform, thinning and shape decomposition.

Image and Video Compression Standards: Lossy and lossless compression schemes: Transform Based, Sub-band Decomposition, Entropy Encoding, JPEG, JPEG2000, MPEG

Computer tomography - parallel beam projection, Radon transform, and its inverse, Back-projection operator, Fourier-slice theorem, CBP and FBP methods, ART, Fan beam projection.

Image texture analysis - co-occurence matrix, measures of textures, statistical models for textures.Hough Transform, boundary detection, chain coding, segmentation and thresholding methods.

References

1. A. K. Jain, *Fundamentals of digital image processing*, PHI, 1989.
2. Gonzalez and Woods, *Digital image processing*,3/E Prentice Hall, 2008.
3. R.M. Haralick, and L.G. Shapiro, *Computer and Robot Vision, Vol-1,* Addison Wesley, Reading, MA, 1992.
4. R. Jain, R. Kasturi and B.G. Schunck, *Machine Vision,* McGraw-Hill International Edition, 1995.

Reading:

5. W. K. Pratt, *Digital image processing*, Prentice Hall, 1989.
6. David A. Forsyth & Jean Ponce, Computer Vision: A modern Approach, Pearson Education, 2003
7. Nikos Paragios, Y. Chen & O. Faugeras, Handbook of Mathematical Models in Computer Vision, Springer 2006
8. C . M. Bishop, "Pattern Recognition & Machine Learning", Springer 2006

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP202 - ESTIMATION AND DETECTION THEORY

3 hours lecture per week

Objective: *To develop understanding about estimation and detection with applications*

Review of Probability Theory, Elementary hypothesis testing, Bayes rule, minimax rule, Neyman-Pearson rule; compound hypothesis testing;LRT, GLRT, UMP test, multiple decision problem; Detection of deterministic and random signals in Gaussian noise; Detection in non-Gaussian noise; Chernoff bound, asymptotic relative efficiency; sequential and distributed detection, sign test, rank test.

Parameter Estimation: Unbiasedness, consistency, Cramer-Rao bound, linear estimators, invariance principle; estimation efficiency, Fisher information matrix sufficient statistics, Rao-Blackwell theorem, least squares, weighted least squares, best linear unbiased estimation, Maximum likelihood estimation, method of moments. Bayesian estimation:MMSE and MAP estimator

Linear Signal Waveform Estimation: Wiener and Kalman Filtering, Lattice filter structure, Levinson Durbin and innovation algorithms.

Applications of detection and estimation Applications in diverse fields such as communications, system identification, adaptive filtering, pattern recognition, speech processing, and image processing

Reference

1. S.M. Kay, *Fundamentals of Statistical Signal Processing:Vols.1&2,* Prentice Hall, 1993, 1998
2. H.L. Van Trees, *Detection, Estimation and Modulation Theory, Part I,* Wiley, 1968.
3. H.V. Poor, *An Introduction to Signal Detection and Estimation,* 2nd edition, Springer, 1994.
4. L.L. Scharf , *Statistical Signal Processing, Detection and Estimation Theory* , Addison-Wesley:1990

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP203 - CODING THEORY

3 hours lecture per week

Objective: *To develop understanding about theory of coding*

(The course requires project based on current literature in place assignment)

Mathematical Preliminaries:groups, rings, fields, the generalized distributive law

Block Codes,Cyclic Codes including Reed Solomon and BCH codes; List decoding of Reed Solomon Codes.

Convolutional Codes: Structures of convolution codes, Suboptimal and optimal decoding of Convolutional codes- Viterbi Algorithm, BCJR algorithm, FanoMetric, Stack Algorithm, Fano Algorithm decoding, Error Analysis of convolution codes, Puctured Convolution codes

Trellis Coded Modulation- Encoding and Decoding

Modern iterative coding,Turbo codes-Encoders, interleavers, turbo decoder,

Low-density Parity-check Codes: Construction, Decoding LDPC Codes-Hard and Soft decoders, Message-passing decoders, Threshold phenomenon and density evolution.

References :

1.Todd K. Moon, Error Control Coding, Mathematical Methods and Algorithms, Wiley

2.P. V. Kumar, M. Win, H-F.Lu, C. Georghiades, Error Control Coding and Techniques and Applications, {chapter in the handbook, Optical Fiber Telecommunications IV};edited by Ivan P. Kaminow and Tingye Li, 2002

3.W.Cary Huffman and Vera Pless, Fundamentals of Error Correcting Codes, Cambridge University Press, 2003

4.L. H. Charles Lee, Convolutional Coding: Fundamentals and Applications, Artech House, Boston

5.Shu Lin and Daniel Costello, Error Control Coding (2^{nd} edition), Pearson, Prentice-Hall, 2004.

6.Rudiger Urbanke and Thomas Richardson, Modern coding theory, Cambridge University Press.

7.R. W. Yeung., Information Theory and Network Coding, Springer, 2008.

8.T. M. Cover and J. A. Thomas, Elements of Information Theory, 2/E, Wiley Interscience, 2006

9.D. Tse and P Viswanath, *Fundamental of Wireless Communication*, Cambridge University Press , 2005.

Additional Readings:

1.The theory of error-correcting codes by F. J. MacWilliams and N. J. A. Sloane (North-Holland publishers).

2.Algebraic codes for data transmission by Richard Blahut (Cambridge).

3. R.E. Blahut, “Theory and Practice of Error Control Coding”, MGH.

4. W.C. Huffman and Vera Pless, “Fundamentals of Error correcting codes”, Cambridge University Press.

5. Rolf Johannesson, Kamil Sh. Zigangirov, “Fundamentals of Convolutional Coding”, Universities Press (India) Ltd.

6. Sklar, ‘ Digital Communication’, Pearson Education.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP204A - STATISTICAL SIGNAL PROCESSING

3 hours lecture per week

Objective: *To develop understanding about statistical signal processing*

Review of fundamentals:-Correlation matrix and its properties, its physical significance. Eigen analysis of matrix, structure of matrix and relation with its eigen values and eigen vectors. Spectral decomposition of corr.matrix, positive definite matrices and their properties their physical significance. Complex Gaussian processes,MA, AR, ARMA processes and their properties, method of Lagrange multipliers.

LMMSE Filters:-Goal of adaptive signal processing, some application scenarios, problem formulation, MMSE predictors, LMMSE predictor, orthogonality theorem (concept of innovation processes), Yule-walker equation, Wiener Solution, Iterative solution of Wiener-Hopf's equation, Levinson Durbin algorithm, inverse Levinson Durbin algorithm., Method of steepest descent and its convergence criteria. Kalman filter, recursions, Extended Kalman filter, comparison of Kalman and weiner filter.

Adaptive filters :- Filters with recursions based on the steepest descent and Newton's method, criteria for the convergence, rate of convergence. LMS filter, mean and variance of LMS, the MSE of LMS and misadjusment, Criteria for convergence and LMS versions: normalized LMS, leaky, sign, variable stepsize, filtered input LMS and complex LMS algorithms. Transform domain LMS algorithm using DFT and DCT, its performance improvement over LMS and Newton's LMS algorithm .

Subband LMS adaptive filters: multirate concepts, decimation, interpolation, perfect reconstruction, oversampled filter bank design and delayless subband adaptive filter.

Block LMS algorithm(BLMS): Frequency domain BLMS(FBLMS), constrained FBLMS, partitioned FBLMS, delayless FBLMS, iterated FBLMS.

Infinite duration impulse response adaptive filters- output error method, equation error method, their problems and solutions. Recursive Least Square(RLS) method, fast transversal, fast lattice RLS and affine projection algorithms.

Tracking performance of the time varying filters: Tracking performance of LMS and RLS filters.

Applications : Spectral Estimation, System identification, channel equalization, noise and echo cancellation.

References

1. B. Farhang-Boroujeny, Adaptive filters:Theory and Applications, John-Wiley, 1998
2. S. Haykin. (1986). *Adaptive Filters Theory*. Prentice-Hall.
3. Dimitris G. Manolakis, Vinay K. Ingle, Stephan M Krgon *: Statistical and Adaptive Signal Processing*, Mc Graw Hill (2000)

Reading:

4. Jones D. *Adaptive Filters* [Connexions Web site]. May 12, 2005. Available at: http://cnx.rice.edu/content/col10280/1.1/

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP204(B) - OPTICAL SIGNAL PROCESSING

3 hours lecture per week

Objective: *To develop understanding about optical signals and their processing techniques*

Need for OSP, Fundamentals of OSP, The Fresnel Transform, Convolution and impulse response, Transform of a slit, Fourier Transforms in Optics, Transforms of aperture functions, Inverse Fourier Transform. Resolution criteria. A Basic Optical System, Imaging and Fourier Transform conditions. Cascaded systems, scale of Fourier Transform Condition. Maximum information capacity and optimum packing density.Chirp _ Z transform and system Coherence.

Spectrum Analysis, Spatial light Modulators, special detector arrays. Performance parameters for spectrum analyzers. Relationship between SNR and Dynamic range. The 2 D spectrum Analyzer.

Spatial Filtering, Linear Space Invariant systems, Parseval's theorem ,Correlation, Input/Output Spectral Densities, Matched filtering, Inverse Filtering. Spatial Filters. Interferometers. Spatial filtering systems. Spatial Modulators . Applications of Optical Spatial Filtering, Effects of small displacements.

Heterodyne systems. Temporal and spatial interference. Optimum photo detector size, Optical radio. Direct detection and Hetero dyne detection. Heterodyne spectrum Analysis. Spatial and temporal Frequencies. The CW signal and a short pulse. Photo detector geometry and bandwidth. Power spectrum analyzer using a CCD array.

Reference

1. Anthony VanderLugt, *Optical Signal Processing*, John Wiley & Sons. 2005.
2. D. Casasent, *Optical data processing-Applications* Springer-Verlag, Berlin, 1978
3. 2. P.M. Dufffieux, *The Fourier Transform and its applications to Optics,* John Wiley and sons 1983
4. J.Horner, *Optical Signal Processing*AcademicPress1988

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 204(C) - MULTIRATE SYSTEMS & FILTERBANKS

3 hours lecture per week

Objective: *To develop understanding about multirate systems and filter banks*

Basic multirate operations and their spectral representation. Linear Periodically Time varying systems, Vaidyanathan's Identities, Efficient represntation of anti alias filters and interpolation Filters, Fractional Sampling rate alteration, Polyphase representation of Uniform DFT filterbanks., Multistage design of Decimation and Interpolation Filters, Applications of Multirate systems.

Special filters and filter banks- half band filters, Mth band filters,power complementaryfilterbanks

Polyphase representation of M-channel filterbanks, Distortions in Fiterbanks, conditions for Perfect Reconstruction (PR), 2-channel QMF filterbanks, PR filterbanks Paraunitaryness, Paraunitary, Factorization of Paraunitary filterbanks, Lattice Structure, 2-channel paraunitary filterbanks, M-channel Paraunitary filterbanks. Cosine Modulated Filterbanks, PR Cosine modulated Filterbanks, Pseudo QMF filterbanks.Tree structuredFilterbanks.

Reference

1. P P Vaidyanathan, *Multirate Systems & Filterbanks* , Prentice Hall
2. G Strang & T Nguyen , *Wavelets and Filterbank,* Wellesly-Cambridge
3. M Vetterli & J Kovacevic, *Wavelets and subband coding,* Prentice Hall

Reading

Douglas F. Elliott, *Handbook of Digital Signal Processing Engineering Application,* Academic Press

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 204(D) - FIBRE OPTIC COMMUNICATION

3 hours lecture per week

Objective: *To develop understanding about fibre optic communication*

Introduction to fiber optics; light propagation;optical fibers: modes, dispersion , nonlinear effects-implementation

Optical transmitters: LEDs, semiconductor lasers, transmitter design

Optical Receivers: Photo detectors, receiver design, noise , sensitivity

System design & Performance: Voice , video , data transmission, analog and digital systems, standards

Broadband Local Area Optical networks and WDM systems; coherent communication systems, long distance telecommunications using optical amplifiers and solitons.

Fiber optic networks: components for optical networks; broadcast and select networks; wavelength routing networks; virtual topology design; control and management; Access networks, deployment considerations

Integrated Optics,MOEMS; microwave photonics,photonics switching,recent developments and futuristic issues.

References :-

1. A. Selvarajan, S. Kar and T. Srinivas, *Optical Fiber Communications, Principles and Systems*, Tata-Mc Graw Hill,2002
2. G.Keiser, *Optical Fiber Communications*, 2/e, McGraw Hill,1991
3. I. P. Kaminov and T. L. Koch, *Optical Fiber Telecommunications* IIIA and IIIB, Academic Press, 1997
4. R. Ramaswaminand K.N.Sivarajan, *Optical Networks: A Practical Perspective*, 2/e, Morgan Kuffmann Publishers, 2002
5. S.V. Kattalopoulos, *Introduction to DWDM Technology*, IEEE Press,2000
6. Current literature: Special issues of journals and review articles

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 204(E) - FINITE FIELDS AND THEIR APPLICATIONS

3 hours lecture per week

Objective: *To develop understanding about finite fields and their applications*

Basics of finite fields: Groups, rings, fields, polynomials, field extensions,

Strucure of finite fields: characterization of finite fields, roots of irreducible polynomials, traces, norms, bases, roots of unity, cyclotomic polynomials, representation of elements of finite fields, Wedderburn's theorem,

Polynomials over finite fields: Order of polynomials, primitive polynomials, construction of irreducible polynomials, linearized polynomials, binomials, trinomials.

Factorisation of polynomials: Factorisation over small finite fields, Factorisation over Large finite fields,

Applications to algebraic coding theory: Linear codes, cyclic codes, Goppa codes.

Texts/References

1. Rudolf Lidl & Harald Niederreiter, Finite Fields, Cambridge University Press, Cambridge, 1997.
2. Steven Roman, Coding and Information Theory, Springer Verlag, 1992.
3. R. Lidl and H. Niederreiter, Introduction to finite fields and their applications, Cambridge University Press, 1986, Chapters 1-3 and 8.
4. Gary Mullen, Mummert : Finite Fields And Applications, American Mathematical Society
5. Oliver Pretzel : Error-Correcting Codes And Finite Fields , Oxford Univ. Press
6. Mceliece : The Theory Of Information And Coding, Cambridge Univ. Press
7. Steven Roman: Coding and Information Theory, Springer

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 205(A) - SPECTRAL ANALYSIS

3 hours lecture per week

Objective: *To develop understanding about spectral analysis*

Power Spectral Density :- Energy spectral density of deterministic signals, Power spectral density of random signals, Properties of PSD,

PSD Estimation : Non-parametric methods :- Estimation of PSD from finite data, Non-parametric methods : Periodogram properties, bias and variance analysis, Blackman-Tuckey method, Window design considerations, time-bandwidth product and resolution - variance trade-offs in window design, Refined periodogram methods : Bartlet method, Welch method.

Parametric method for rational spectra :- Covariance structure of ARMA process, AR signals, Yule-Walker method, Least square method, Levinson-Durbin Algorithm, MA signals, Modified Yule-Walker method, Two-stage least square method, Burg method for AR parameter estimation.

Parametric method for line spectra :- Models of sinusoidal signals in noise, Non-linear least squares method, Higher order Yule-Walker method, MUSIC and Pisayenko methods,Min-norm method, ESPIRIT method

Filterbank methods :- Filterbank interpertation of periodogram, Slepia base-band filters, refined filterbank method for higher resolution spectral analysis, Capon method, Introduction to higher order spectra.

Reference

1. Stoica , R.L. Moses, *Introduction to Spectral Analysis*, Prentice Hall
2. Kay SM, *Modern Spectral Estimation Theory & Applications*, Prentice Hall

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP205(B) - SPEECH SIGNAL PROCESSING

3 hours lecture per week

Objective: *To develop understanding about techniques to process speech signals*

(The course requires project based on current literature in place assignment)

Speech Production :- Acoustic theory of speech production (Excitation, Vocal tract model for speech analysis, Formant structure, Pitch). Articulatory Phonetic (Articulation, Voicing, Articulatory model). Acoustic Phonetics (Basic speech units and their classification).

Speech Analysis :- Short-Time Speech Analysis, Time domain analysis (Short time energy, short time zero crossing Rate, ACF). Frequency domain analysis (Filter Banks, STFT, Spectrogram, Formant Estimation &Analysis). Cepstral Analysis

Parametric representation of speech :- AR Model, ARMA model. LPC Analysis (LPC model, Auto correlation method, Covariance method, Levinson-Durbin Algorithm, Lattice form).LSF, LAR, MFCC, Sinusoidal Model, GMM, HMM

Speech coding :- Phase Vocoder, LPC, Sub-band coding, Adaptive Transform Coding, Harmonic Coding, Vector Quantization based Coders, CELP
Speech processing :- Fundamentals of Speech recognition, Speech segmentation. Text-to-speech conversion, speech enhancement, Speaker Verification, Language Identification, Issues of Voice transmission over Internet.

Reference :-

1. Douglas O'Shaughnessy, *Speech Communications : Human & Machine*, IEEE Press, Hardcover 2/e, 1999
2. Nelson Morgan and Ben Gold, *Speech and Audio Signal Processing : Processing and Perception Speech and Music*, July 1999, John Wiley & Sons
3. Rabiner and Schafer, *Digital Speech Processing* , Prentice Hall, 1978.
4. Rabiner L. R. and Juang B. H., *Fundamentals of Speech Recognition*, Prentice Hall, 1993.
5. Parsons T. W., Voice & Speech Processing Mc-GrawHill, 1989
6. Thomas F. Quatieri, *Discrete-Time Speech Signal Processing: Principles and Practice*, Prentice Hall
7. Donald G. Childers, *Speech Processing and Synthesis Toolboxes*, John Wiley & Sons, September 1999

Current Literature – for course project.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 205(C) - COMMUNICATION NETWORKS

3 hours lecture per week

Objective: *To develop understanding about communication networks*

Introduction to networking, TCP and UDP, TCP Analysis. IP, Optimal Routing, algorithms for shortest path routing, routing protocols, mobile IP. ARQ shemes and analysis, random access, random/slotted ALOHA, splitting algorithms

CSMA-CD, wireless LANs CSMA/CA. Modelling and Performance analysis in networks; deterministic analysis, scheduling

Stochastic Analysis- traffic models, performance measures, Little's Theorem, M/G/1 model, priority queueing

Protocols and Architectures, the layered approach :OSI model, TCP/IP protocol suite, principles of internetworking, distributed applications: network management, e-mail.

TCP/IP Networking: IP addressing, IP header, subnetting and supernetting, CIDR, ethernet, ARP, serial links, PPP, ICMP, UDP, TCP: header, connection establishment, ISN, half close, delyed acks, header flags, ftp and tcp, state transitions, sliding windows, slow start, congestion avoidance, fast retransmit, fast recovery, DNS, multicasting, IGMP, IEEE 802.11 wireless LANs

References

1. A. Kumar, D. Manjunath, and J. Kuri, *Communication Networking-An Analytical Approach*, Morgan Kaufman Publishers, 2004
2. B. Bertsekas and R. Gallager, *Data Networks*, 2/E, Prentice-Hall India, 2002
3. P. Venkataraman and S. K. Manvi, *Basics of Communication Protocol Engineering*, PHI, 2004
4. W. Richard Stevens, *TCP/IP illustrated vol 1: The Protocols*, Pearson Education Asia, 2000
5. J. F. Kurose and K. W. Ross, *Computer Networking- A Top-Down Approach Featuring the Internet*, Pearson Education Asia, 2001
6. A. S. Tannenbaum, *Computer Networks*, Prentice Hall, 1997
7. W. Stallings, *Data and Computer Communications*, Prentice Hall, 1996
8. Douglas Camer, *Internetworking with TCP/IP vol 1: Principles, Protocols and Architecture*, Prentice-Hall, 4/e, 2000

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 205(D) - INFORMATION HIDING & DATA ENCRYPTION

3 hours lecture per week

Objective: *To develop understanding about information hiding and data encryption*

Introduction to Complexity theory, Elementary Number theory, Algebraic Structures-Groups, Rings and Finite Fields, Polynomials over Finite Fields (Fq). Classical Cryptography, Stream Ciphers, Public Key Cryptography: based on Knapsack problem, AES. Digital Signature, Zero Knowledge Proofs.

Information Hiding: Watermarking, Steganography. Objectives, difference, requirements, types (Fragile and robust). Parameters and metrics (BER, PSNR, WPSNR, Correlation coefficient, MSE, Bit per pixel). LSB, additive, spread spectrum methods. Applications: Authentication, annotation, tamper detection and Digital rights management. Hiding text and image data, mathematical formulations, Adaptive steganography, Costa's approach, hiding in noisy channels, Information theoretic approach for capacity evaluation

Hiding in 1D signals: Time and transform techniques-hiding in Audio, biomedical signals, HAS Adaptive techniques.

Hiding in 2D signals: Spatial and transform techniques-hiding in images, ROI images, HVS Adaptive techniques.

Hiding in video: Temporal and transform domain techniques, Bandwidth requirements.

Steganalysis: Statistical Methods, HVS based methods, SVM method, Detection theoretic approach.

Quality evaluation: Benchmarks, Stirmark, Certimark, Checkmark, standard graphs for evaluation.

Reference

1. Neal Koblitz, *A Course in Number Theory and Cryptography*, 2nd Edition, Springer
2. Stefan Katzenbeisser, Fabien A. P. Petitcolas, *Information Hiding Techniques for Steganography and Digital Watermarking*, Artech House Publishers, 2000.
3. Neil F Johnson et al Kluwer, *Information hiding: steganography and watermarking attacks and countermeasures* Academic Publishers London.
4. Ingmar J Cox eta al, *Digital Watermarking*, Morgan Kaufman Series, Multimedia information and system.

Reading

1.Ira S Moskowits, *Proceedings, 4th international workshop,* IH 2001, Pitts burg, USA April 2001 Eds
2.AVISPA package homepage ,http:/ www.avispaproject.org/
3.AJ Menezes etc al, Handbook of Applied Cryptography,CRC Press

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 205(E) - FOURIER AND WAVELET ANALYSIS

3 hours lecture per week

Objective: *To develop skills of analysis using fourier and wavelet transform techniques*

Fourier Transform : Fourier series, The Riemann- Lebesgue Lemma, The Gibbs phenomenon, Fourier transforms, Properties, convolution, Sine and cosine transform , Parseval's identities, L^2 theory, Plancherel theorem.

Discrete Fourier transform: Discrete Fourier transform, Properties of DFT, Inversion theorem for DFT, Cyclic convolution, Fast Fourier transform for $N=2^k$, Discrete signals, time invariant discrete linear filters, Z-Transform and transfer functions.

Wavelets: Orthonormal basis from one function, Multiresolution analysis, Mother wavelets yield wavelet bases, MRA to mother wavelet., Shannon wavelet, Riesz bases and MRAs, Haar wavelet, Daubechies Wavelet, Franklin Wavelet, Frames and splines. Computational complexity, wavelet algorithm, Wavelet packets. The continuous wavelet transform, Short time wavelet transform, Inversion formula for wavelet transform.

Text/ Reference:

1. G. Bachman, L. Narici and E Beckenstein: Fourier and wavelet Analysis, Springer-Verlag, New York/Berlin/Heidelberg, 2000
2. A Boggess and F. J. Narcowich: A first course in wavelets with Fourier analysis, John wiley, 2009
3. M.W. Frazier: An Introduction to Wavelets Through Linear Algebra
4. J C Goswami and A K Chan: Fundamentals of Wavelets: Theory, Algorithms, and Applications, John wiley , 2011

Question Pattern:

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CSP 206(A) - OPTIMIZATION TECHNIQUES

3 hours lecture per week

Objective: *To develop understanding of optimisation techniques*

Unconstrained optimization: - Necessary and sufficient conditions for local minima, one dimensional search methods, gradient methods - steepest descent, Inverse Hessian, Newton's method, conjugate direction method, conjugate gradient algorithm, quasi Newton methods

Linear Programming : - Convex polyhedra, standard form of linear programming, Basic solutions, Simplex algorithm, Matrix form of the simplex algorithm, Duality, non simplex methods : Khachiyan method, Karmarkar's method

Nonlinear Constrained Optimization: - equality constraints – Lagrange multipliers, inequality constraints – Kuhn-Tucker conditions, Convex optimization, Geometric programming, Projected gradient methods, Penalty methods

Introduction to graph theory and combinatorial optimization:- Routing-traveling salesman; Assignment – satisfiabilty, constraint saisfiabilty, graph coloring; Subsets- set covering, partitioning; Scheduling; Shortest path and Critical path algorithms

References

1. Edwin K. P. Chong, Stanislaw H. Zak**,** *An Introduction to Optimization*,2nd Ed, John Wiley & Sons
2. Stephen Boyd, Lieven Vandenberghe, *Convex Optimization*, CUP, 2004.
3. R. Fletcher, *Practical methods of Optimization*, Wiley, 2000
4. Jonathan L Grosss, Jay Yellen, Chapmamn and Hall, *Graph theory and its application*, 2e, CRC pub,
5. Alan Tucker, *Applied Combinatorics*, John wiley and Sons

Reading

1. Dimitri P. Bertsekas, *Nonlinear programming*, Athena Scientific
2. Belegundu, *Optimization Concepts and Applications in Engineering*, Prentice Hall, 2000
3. N Christofied, A Mingoss, P Toth, C Sandi, *Combinatorial Optimization*, John wiley & Sons
4. Sivan Pemmaraju, S Skiens, *Computational Discrete Mathematics*, CUP2003

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 206(B) - ARRAY SIGNAL PROCESSING

3 hours lecture per week

Objective

The focus of the course is to enable the students to understand the one to one correspondence of spatial signals with time domain signals and hence equip them to apply the time domain signal processing techniques in spatial domain.

Spatial Signals :- Signals in space and time. Spatial frequency, Direction vs. frequency. Wave fields. Far field and Near field signals.

Sensor Arrays :- Spatial sampling, Nyquist criterion. Sensor arrays. Uniform linear arrays, planar and random arrays. Array transfer (steering) vector. Array steering vector for ULA. Broadband arrays.

Spatial Frequency :- Aliasing in spatial frequency domain. Spatial Frequency Transform, Spatial spectrum. Spatial Domain Filtering. Beam Forming. Spatially white signal.

Direction of Arrival Estimation :- Non parametric methods – Beam forming and Capon methods. Resolution of Beam forming method. Subspace methods – MUSIC, Minimum Norm and ESPRIT techniques. Spatial Smoothing.

Reference

1. Dan E. Dugeon and Don H. Johnson. (1993). *Array Signal Processing: Concepts and Techniques.* Prentice Hall.
2. Petre Stoica and Randolph L. Moses. (2005, 1997*) Spectral Analysis of Signals.* Prentice Hall.
3. Bass J, McPheeters C, Finnigan J, Rodriguez E. *Array Signal Processing* [Connexions Web site]. February 8, 2005. Available at: http://cnx.rice.edu/content/col10255/1.3/

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 206(C) RESEARCH METHODOLOGY

3 hours lecture per week

Objective: *To develop understanding about techniques for research*

Introduction – Meaning of research – Objectives of research – Motivation in research – Types of research – Research approaches – Significance of research – Research methods vs Methodology – Criteria of good research.

Defining Research Problem – What is a research problem – Selecting the problem – Necessity of defining the problem – Literature review – Importance of literature review in defining a problem – Critical literature review – Identifying gap areas from literature review

Research design – Meaning of research design – Need– Features of good design – Important concepts relating to research design – Different types – Developing a research plan

Method of data collection – Collection of data- observation method – Interview method –Questionnaire method – Processing and analysis of data – Processing options – Types of analysis – Interpretation of results

Report writing – Types of report – Research Report, Research proposal ,Technical paper – Significance – Different steps in the preparation – Layout, structure and Language of typical reports – Simple exercises – Oral presentation – Planning – Preparation – Practice – Making presentation – Answering questions - Use of visual aids – Quality & Proper usage – Importance of effective communication – Illustration

References

1. Coley S M and Scheinberg C A, 1990, *"Proposal Writing"*, Newbury Sage Publications.
2. Leedy P D, *"Practical Research : Planning and Design"*, 4th Edition, N W MacMillan Publishing Co.
3. Day R A, *"How to Write and Publish a Scientific Paper"*, Cambridge UniversityPress,1989.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP206(D) - WIRELESS COMMUNICATION II

3 hours lecture per week

Objective: *To develop solid understanding of wireless communication*

Spread Spectrum systems—FHMA, CDMA, Time-Hopping; Multi-user systems—multiple access

methods, random access methods, power control, Up-link and Downlink channel capacity, capacity

with multiple antenna, Multiuser Diversity, Diversity techniques—Transmitter and receiver diversity,

introduction to MIMO systems, space-time communication, MIMO multiuser system; Cellular

System based wireless network— Shannon Capacity for cellular system, channel re-use, allocation,

traffic handling capacity, GSM (channel type, architecture, call-making), System level study of GSM

3G and 4G; Introduction to Cooperation in wireless network, Ad Hoc wireless network, Cognitive

Radio, Spectrum sensing and beamforming

References:

1. D. Tse, Pramod Viswanath,*Fundamentals of Wireless communication*, Cambridge *University press*
2. Andrea Goldsmith, *Wireless Communication*, Cambridge university press
3. Ramjee Prasad & Kwan-Cheng Chen, *Cognitive Radio Networks*, Wiley publications
4. Andreas F Molisch, *Wireless communication* , Wiley
5. Mischa Schwartz , *Mobile wireless communication* , Cambridge university Press
6. S. Verdu, *Multiuser detection*, Cambridge Univ. Press , 1998

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP206(E) - NUMBER THEORY AND CRYPTOGRAPY

3 hours lecture per week

Objective: *To develop understanding about the principles of number theory used in cryptography*

Topics In Number Theory:. Divisibility and the Euclidean algorithm. Fundamental theorem of arithmetic, Euler function, Congruences. Complete residue system, Reduced residue system, Euler theorem- Fermatt's little theorem- Wilson's theorem- The Chinese reminder theorem-Some applications to factoring.

Finite Fields And Quadratic Residues: Finite fields. Existence and uniqueness of finite fields, Quadratic residues and reciprocity, Legendre symbol. Law of quadratic reciprocity. Jacobi symbol.

Public Key Cryptography: Some simple cryptosystems. Enciphering matrices. The idea of public key cryptography. Discrete logarithm. The Diffie-Hellman key exchange system,Massey-Omura and ElGamal cryptosystem, Algorithm for finding discrete logarithm,. Pohlig-Hellman algorithm.

Primality , Factoring And RSA: Euler's formula for *pq*. RSA public key cryptosystem primality cheking Pollard's *p*-1 factorisation algorithm. Pseudoprimes, The Rho method, Fermat factorization and factor bases

Ellptic Curves: Elliptic curves. Elliptic curves over finite fields. Elliptic curve discrete logarithm. Elliptic curve cryptosystems. Elliptic curve primality test. Lenstra's Elliptic curve facorisation algorithm.

Text books:

1. Neal Koblitz, A Course in Number and Theory and Cryptography, Graduate Texts in Mathematics No.114, Springer-Verlag, New York/Berlin/Heidelberg, 1987.
2. J. Hoffstein, J.Pipher and J.H. Silverman: An introduction to Mathematical Cryptography, Springer-Verlag, New York/Berlin/Heidelberg, 2008

Additional references:

1. Vasilenko : Number-theoretic Algorithms In Cryptography, American Mathematical Society
2. S.Y. Yan : Primality Testing And Integer Factorization In Public-key Cryptography, Kluwer Academic
3. Baldoni, Ciliberto,Cttaneo : Elementary Number Theory, Cryptography And Codes, Springer
4. Hankerson & Menezes : Guide To Elliptic Curve Cryptography, Springer
5. Neal Koblitz : ALGEBRAIC ASPECTS OF CRYPTOGRAPHY, Springer
6. JOSEPH H. SILVERMAN : THE ARITHMETIC OF ELLIPTIC CURVES, Springer
7. Alan Baker, A Concise Introduction to the Theory of Numbers, Cambridge University Press, New York/Port Chester/Melbourne/Sydney, 1990.
8. A.N. Parshin and I.R. Shafarevich (Eds.), Number Theory, Encyclopaedia of Mathematics Sciences, Volume 49, Springer-Verlag, New York/Berlin/Heidelberg, 1995.
9. John Stillwell, Elements of Number Theory, Undergraduate Texts in Mathematics, Springer-Verlag, New York/Berlin/Heidelberg, 2003.
10. Henk C.A. van Tilborg, An Introduction to Cryptology, Kluwer Academic Publishers, Boston/Dordrecht/Lancaster, 1988.

11. Talbot, Welsh : Complexity And Cryptography, Cambridge University Press

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CSP 207(P) - VLSI AND EMBEDDED SYSTEMS LAB

DSP Fundamentals Using TMS320C6713/6455

1. Linear & Circular Convolution, DFT and IDFT Implementation, Waveform/Tone Generation using codec and serial port on DSK.
2. Advanced Discrete time filter design and its real time implementation.
3. Implementation of Speech Processing Applications.
4. Image Processing Applications

Digital Signal Processing Using FPGA

1. Implementation of DSP algorithms using FPGA
2. Implementation of DSP filters using FPGA

Software used: Code Composer Studio, Matlab, Xilinx Foundation series

Platforms used: PC, TMS320C6713/6455 Starter Kits, Xilinx/ Altera FPGA Kits

REFERENCES:

1. Naim Dahnoun, *Digital Signal Processing Implementation Using the TMS320C6000 DSP Platform*, 1/E
2. Rulph Chassaing, *DSP Applications using 'C' and the TMS320C6X DSK*, 1/E
3. U. Meyer Baese, *Digital Signal Processing with Filed Programmable Gate Arrays*: 2nd Edition,Springer
4. David J Defatta J, Lucas Joseph G & Hodkiss William S, *Digital Signal Processing: A System Design Approach*, 1/E, John Wiley
5. Kuo, Sen M, Lee, Bob H, *Real Time Digital Signal Processing: Implementations, Applications, and Experiments with the TMS320C55X*, John Wiley & Sons Ltd.
6. B. Venkataramani & M.Bhaskar , *Digital Signal Processing – Architecture, Programming and Applications*, Tata McGraw Hill
7. T.J. Terrel and Lik-Kwan Shark , *Digital Signal Processing - A Student Guide*, 1/E, Macmillan Press

In addition, National/ International journals in the field, manufacturers Device data sheets and application notes and research papers in journals are to be referred to get practical and application oriented information.

Sessional work assessment

Regularity – 5 marks
Class work, Lab Record, Mini project Report (if any), viva – 30 marks
Test – 15 marks
Total: Internal continuous assessment: 50 marks

University evaluation

Examination will be for 100 marks of which 70 marks are allotted for writing the procedure/formulae/sample calculation details, preparing the circuit diagram/algorithm/flow chart, conduct of experiment, tabulation, plotting of required graphs, results, inference etc., as per the requirement of the lab experiments, 20 marks for the viva-voce and 10 marks for the lab record.

Note: Duly certified lab record must be submitted at the time of examination

CSP208 (P) TERM PAPER

The student is expected to present a report on the literature survey conducted as a prior requirement for the project to be taken up in the third and fourth semesters. Head of department can combine TP hours of many weeks and allot a maximum of 4 weeks exclusively for it. Students should execute the project work using the facilities of the institute. However, external projects can be taken up, if that work solves a technical problem of the external firm. Prior sanction should be obtained from the head of department before taking up external project work. Project evaluation committee should study the feasibility of each project work before giving consent. An overview on the project work should be introduced before the closure of first semester. A paper should be prepared based on the project results and is to publish in refereed Conferences/Journals. Grades will be awarded on the basis of contents of the paper and the presentation.

Sessional work assessment
Presentation : 25
Report : 25
Total marks : 50

CSP301 THESIS – PRELIMINARY

This shall comprise of two seminars and submission of an interim thesis report. This report shall be evaluated by the evaluation committee. The fourth semester Thesis-Final shall be an extension of this work in the same area. The first seminar would highlight the topic, objectives, methodology and expected results. The first seminar shall be conducted in the first half of this semester. The second seminar is presentation of the interim thesis report of the work completed and scope of the work which is to be accomplished in the fourth semester.

Weightages for the 8 credits allotted for the Thesis-Preliminary
Evaluation of the Thesis-Preliminary work: by the guide - 50% (200 Marks)
Evaluation of the Thesis–Preliminary work: by the Evaluation Committee-50%(200 Marks)

CSP401 THESIS

Towards the end of the semester there shall be a pre submission seminar to assess the quality and quantum of the work by the evaluation committee. This shall consists of a brief presentation of Third semester interim thesis report and the work done during the fourth semester. At least one technical paper is to be prepared for possible publication in journals / conferences. The final evaluation of the thesis shall be an external evaluation. The 12 credits allotted for the Thesis-Final may be proportionally distributed between external and internal evaluation as follows.

Weightages for the 12 credits allotted for the Thesis
Internal Evaluation of the Thesis work: by the guide - (200 Marks)
Internal Evaluation of the Thesis work: by the Evaluation Committee - (200 Marks)

Final Evaluation of the Thesis work by the Internal and External Examiners:-
(Evaluation of Thesis + Viva Voce) - (100+100 Marks)