Goa University

P.O.Goa University, Taleigao Plateau, Goa 403206, India

M.E. IN ELECTRONICS AND TELECOMMUNICATION
(ELECTRONICS COMMUNICATION & INSTRUMENTATION)

Course Structure and Scheme of Evaluation (Semester-wise, along with curriculum details)
Implemented from the Academic Year 2008-2009

Scope and Purpose:

The objective of the Masters programme in Electronics Communication and Instrumentation is to provide a thorough and in-depth study in the field of Communication and Instrumentation with hands on experience on Fiber optics, VLSI programming, MIC and Biomedical applications. The core programme is supplemented and further reinforced by a well-chosen set of elective courses permitting students to specialize either in the software or hardware aspect of Communication Systems.

- **Programme Educational Objectives (PEO)**

  To acquire good scientific and engineering knowledge & skills so as to comprehend, analyze, design and create innovative solutions for real life problems.

  To imbibe professional ethics, develop team spirit and effective communication skills to be successful leaders and managers with holistic approach.

  To embrace and explore evolving technologies with due emphasis on environmental and social issues

  Developing entrepreneurial skills with global perspective.

- **Prerequisites:**

  The candidates are required to possess Bachelor's degree in Electronics and Telecommunication / Electronics/ Electrical/ Electrical and Electronics/ Information Technology/ Computers/ Instrumentation/ Biomedical Instrumentation/ Biomedical Electronics/ Process Control /Industrial Electronics/ Power Electronics or AMIE/IETE or equivalent from recognized University.

- **Credits:**

  The Programme provides for an aggregate of 152 credits, spanning 12 theory Courses, spread across three Semesters, with each Course carrying a uniform six Credits. The lab work is spread across two Semesters, with each 4 lab Courses each carrying 4 Credits and a total of 16 credits. The Project work is spread across two Semesters and carries a total of 40 credits.

  - **Course Distribution:**

    First two Semesters, students are offered five (05) Compulsory theory courses and two (02) Compulsory lab courses, totaling seven (07) in first two Semesters. In the third Semester, students are offered two (02) elective courses. The Dissertation work starts in the third Semester and continues till the end of the fourth Semester.

  - **Assessment:**

    A student undergoes continuous assessment as well as a semester end assessment. He/She answers three(03) internal tests out of which the best two are considered in granting the Internal credits of 2 each course. He/She is also required to submit assignments, give presentations and do a mini-project. He/She answers a theory

paper of 100 marks and 3 hours duration for each theory course at the end of the Semester for six (06) credits per course and practical exam for two courses in the first two Semester for two(02) credits.

Semester 1

Subject code	Name of the Subjects	Hrs / Week		Evaluation (marks)				Credits		
		Lectures	Practical	Internal	External		Total	T	P	I
					Theory	Practical				
MECI 1.1	Solid state devices and IC techniques	4	0	25	100	0	125	6	-	2
MECI 1.2	Fiber optic communication	4	0	25	100	0	125	6	-	2
MECI 1.3	Radiating systems	4	0	25	100	0	125	6	-	2
MECI 1.4	CMOS Analog VLSI design	4	0	25	100	0	125	6	-	2
MECI 1.5	Introduction to MEMS	4	0	25	100	0	125	6	-	2
MECI 1.6	Fiber optics lab	0	4	25	0	100	125	-	2	2
MECI 1.7	VLSI lab	0	4	25	0	100	125	-	2	2

Semester 2

Subject code	Name of the Subjects	Hrs / Week		Evaluation (marks)				Credits		
		Lectures	Practical	Internal	External		Total	T	P	I
					Theory	Practical				
MECI 2.1	Biomedical Instrumentation	4	0	25	100	0	125	6	-	2
MECI 2.2	Telemetry	4	0	25	100	0	125	6	-	2
MECI 2.3	Adaptive signal processing	4	0	25	100	0	125	6	-	2
MECI 2.4	Microwave integrated circuits	4	0	25	100	0	125	6	-	2
MECI 2.5	Information theory and coding	4	0	25	100	0	125	6	-	2
MECI 2.6	Microwave Lab	0	4	25	0	100	125	-	2	2
MECI 2.7	Biomedical Lab	0	4	25	0	100	125	-	2	2

Semester 3

Subject code	Name of the Subjects	Hrs / Week		Evaluation (marks)				Credits		
		Lectures	Practical	Internal	External		Total	T	P	I
					Theory	Practical				
MECI 3.1	Elective-1	4	0	25	**100**	**0**	125	6	-	2
MECI 3.2	Elective-II	4	0	25	**100**	**0**	125	6	-	2
MECI 3.3	Thesis Seminar	0	20	50	**0**	**100**	150	-	8	4

Elective 1:

a) Optical computing
b) RF Microelectronic chip design
c) Power electronics

d) Embedded system design
e) Electronic system design
f) Advanced Optical Communication

Electives 2
g) Sensors in instrumentation
h) Simulation of circuits and devices
i) Image processing
j) Error correcting codes
k) Industrial design of electronic equipments

Semester 4

Thesis work
Thesis work will start from the 3rd semester and will continue in the 4th semester

SYLLABUS

M.E. IN ELECTRONICS AND TELECOMMUNICATION

(ELECTRONICS COMMUNICATION & INSTRUMENTATION

SEMESTER 1

1. Solid state devices and IC techniques

Semiconductor devices : junction diode , zener diode, tunnel diode, BJT, FET, MOSFET, Schottky diode, switching diode, UJT, SCR – characteristics, parameters, equipment circuits and basic application circuits

Basic device technology: depletion region and diffusion capacitance, junction breakdown , breakdown voltage enhancement in pn junction, beveling and concentration , profiling techniques.thermal properties and second breakdown phenomenon, calculation of reverse leakage current. Silicon-silicon dioxide interface

MOS transistor: Pao- Sah and Brews models; short channel effects in semiconductors. Hot carrier effects in Mos transistors; quasi static compact models of MOS transistors;measurement of MOS transistor parameters;scaling and transistor structures for ULSI; silicon-on-insulators transistors;high field and radiation effects in transistors

Bipolar transisotors : Ebers – mall model , heterojunction BJT ,JFET, MESFET high current and high frequency effects

IC technology: diffusion ,oxidation, epitaxial growth, experiments in device technology

Texts/References

1) Physics of semiconductor technology By S. M. Sze (Wiley eastern ltd.)
2) Microelectronics By Jacob Millman (McGraw Hill)
3) Silicon integrated device technology By Burger and Donovan (Prentice Hall international)
4) Diffusion in solids By Rungam

2. Fiber optic communication

Introduction to vector nature of light, propagation of light in a cylindrical dielectric rod, ray model, wave model. Different types of optical fibers, model analysis of a step index fiber.

Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibres and measurement techniques like OTDI.

Optical sources- LEDs and laser, photodetectors- Pin detectors, detector responsivity, noise, optical receivers.

Optical link design –BER calculation , quantum limit, power panelities.

optical switches- coupled mode analysis of directional couplers, electro-optics switches.

Non linear effects in fibre optics link .concept of self –phase modulation, group velocity dispersion and solition based communication. Opticl amplifiers-EDFA , raman amplifiers, and WDEM systems.

Texts/References

1) J.Keiser, Fibre Optic communication, McGraw-Hill, 2nd Ed. 1992.
2) J.E. Midwinter, Optical fibers for transmission, John Wiley, 1979.
3) T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
4) J.Gowar, Optical communication systems, Prentice Hall India, 1987.
5) S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.
6) G.Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
7) G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1992
8) F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).

3. Radiating systems

Review of antenna theory, dipoles, monopoles and loop antennas, linear and planar arrays , array synthesis, phased arrays, helical antennas, radiation from apertures, aperture distribustion, horn and parabolic dish antennas, yagi –uda, and log- periodic antennas, micro strip antennas, and arrays , dielectric antennas.

Texts/References

1) J.D. Karus, Antennas, McGraw Hill, 1988.
2) C.A. Balanis, Antenna Theory - Analysis and design, John wiley, 1982.
3) R.E. Collin, Antennas and radiowave propagation, McGraw Hill, 1985.
4) R.C. Johnson and H. Jasik, Antenna Engineering Handbook, McGraw Hill, 1984.
5) I.J. Bahl and P. Bhartia, Microstrip antennas, Artech house,1980.

4. CMOS Analog VLSI design

Introduction to analog VLSI and mixed signal issues in CMOS technologies. Basic MOS models, SPICE Models and frequency dependent parameters. Basic MNOS/CMOS gain stage, cascade and cascode circuits. Frequency response, stabilty and noise issues in amplifiers. CMOS analog blocks: Current Sources and Voltage references. Differential amplifier and OPAMP design. Frequency Synthesizers and Phased lock-loop. Non-linear analog blocks: Comparators,Charge-pump circuits and Multipliers. Data converters. Analog Interconnects. Analog Testing and Layout issues. Low Voltage and Low Power Circuits. Introduction to RF Electronics. Basic concepts in RF design

Text/References

1) R.Jacob Baker,H.W.Li, and D.E. Boyce CMOS Circuit Design ,Layout and Simulation, Prentice-Hall of India,1998
2) Mohammed Ismail and Terri Faiz Analog VLSI Signal and Information Process, McGraw-Hill Book company,1994
3) Paul R. Gray and R.G.Meyer, Analysis and design of Analog Integrated circuits John Wiley and sons,USA,(3rd Edition),1993
4) B. Razavi, RF Microelectronics, Prentice-Hall PTR,1998

5. Introduction to MEMS

Introduction: MEMS applications in engineering, properties of single crystal silicon, anisotropy.
Photolithography, environment for microfabrication, surface micromachining techniques
Doping and the solution of the diffusion equation. Thin film characterization, residual stresses, thermal stress calculation in thin films. Bulk silicon micromachining. Sensing principles: piezoresistivity, sensitivity of anisotropic piezoresistors. Capacitive sensing and actuation, piezoelectric sensing and actuation. Elasticity effects: stiffness and equilibrium. Stability of electrostatic actuators, dynamic responses of MEMS structures. M icrofluidics, viscous flow calculations.

Texts/References

1) Tai-Ran Hsu, MEMS & Microsystems: Design and Manufacture. McGraw Hill, New York, 2002.
2) Nadim Maluf, An Introduction to Microelectromechanical Systems Engineering, Artech House, 2000.
3) M.H. Bao, Micro Mechanical Transducers, Volume 8, Handbook of Sensors and Actuators, Elsevier, 2000.
4) Masood Tabib-Azar, Microactuators, Kluwer, 1998.
5) Ljubisa Ristic, Editor, Sensor Technology and Devices, Artech House, 1994
6) D. S. Ballantine, et. al., Acoustic Wave Sensors, Academic Press, 1997
7) H. J. De Los Santos, Introduction to Microelectromechanical (MEM) Microwave Systems, Artech, 1999.
8) James M.Gere and Stephen P. Timoshenko, Mechanics of Materials, 2nd Edition, Brooks/Cole Engineering Division, 1984

6. Fiber optics lab

7. VLSI Design - Lab

SEMESTER 2

1. Biomedical Instrumentation

Brief introduction to human physiology. Biomedical transducers: displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases.

Bioelectrodes and biopotential amplifiers for ECG, EMG, EEG, etc. Measurement of blood temperature, pressure and flow. Impedance plethysmography. Ultrsonic and nuclear imaging.

Sources of bio electric potentials and electrodes

The Cardiovascular system and cardio vascular measurements

Patient care and monitoring and measurements in respiratory system

Bio telemetry and instrumentation for the clinical lab

X-ray and radio isotope instrumentation and electrical safety of medical equipment

Prostheses and aids: pacemakers, defibrilla-tors, heart-lung machine, artificial kidney, aids for the handicapped. Safety aspects.

Text/References

1) W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.
2) J.G. Websster, ed., Medical Instrumentation, Houghton Mifflin, 1978.
3) A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982.
4) Biomedical Transducers and Instruments by Tatsuo Togawa, P. Ake Oberg, Toshiyo Tamura, P. Åke Öberg
5) Signals and Systems Analysis in Biomedical Engineering by Robert B. Northrop
6) Bioimpedance and Bioelectricity Basics by Sverre Grimnes, Ørjan Grøttem Martinsen

2. Telemetry

CLASSIFICATION OF TELEMETRY SYSTEMS

Voltage, current, position, frequency, pulse, land – line and radio telemetry. telemetry system overview, Bio-telemetry; radio telemetry services single and multi-channel telemetry circuits.

LAND – LINE TELEMETRY

Voltage telemetering system current telemetering system motion balance current telemetering system force balancing current telemetering system position telemetering system using bridge configuration position telemetering system using synchors.

AMPLITUDE MODULATION AND DEMODULATION OF A CARRIER WAVE

Expression for an AM – wave frequency spectrum of an AM – wave bandwidth AM – detector illustration of AM for a measuring system full – wave phase sensitive demodulator block diagram of a carrier amplifier system.

FREQUENCY MODULATION AND DEMODULATION OF A CARRIER WAVE

Expression for an FM – wave frequency spectrum of an FM – wave bandwidth diode FM modulator reactance modulator phase shift discriminator ratio detector.

AMPLITUDE MODULATION AND DEMODULATION CIRCUITS FOR MESURENT SYSTEMS:

Basic configuration for a modular electronical chopper semiconductor modulator balanced modulator basic configuration of a demodulator chopper demodulator semiconductor demodulators balanced demodulator.

MULTIPLEXING IN TELEMETRY SYSTEMS: Block diagram of a multiplexer and its mechanical switch equivalent block diagram of a demultiplexer and its mechanical switch equivalent frequency division multiplexing time division multiplexing sample –and – hold circuit an outline of pulse modulation techniques used in telemetry.

RADIO TELEMETRY SYSTEMS: Analog TDM system FM – FM telemetry system standard telemetry channel frequencies for FDM block diagrams of PAM, PCM and FDM telemetry systems.

TRANSMISSION CHANNEL: Wire line channels, radio channels, micro – wave channels, power line carrier channels and fiber optic transmission.

Text/References

Electrical and electronic measurements and instrumentation, by A.K. Sawhney, Dhanpat Rai & Sons.
Introduction to Telemetry by Alan Andrews, Foulsham – Sams technical books, Published by W – Foulsham & Co
Ltd., England.
Understanding telemetry circuits, by John D. Lenk, Foulsham – Sams technical books, Published by W. Foulsham &

3.Adaptive signal processing

Review of linear and non-linear estimation theory. Signal modelling. Optimal filtering.
Adaptive filtering as an extension of the optimal least mean square error case Adaptive algorithms: adaptive equalization and echo cancellation; adaptive lattice filters. Application to radar, sonar, geophysics and hydrology, economic processes, communications (spread spectrum techniques).

Texts/References

1) S. Haykin, Adaptive filter theory, Prentice Hall, 1986.
2) B. Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.

4. Microwave integrated circuits

Introduction to microwave integrated circuits: Active and passive components.
Analysis of microstrip lines: variational method, conformal transformation, numerical analysis; losses in microstrip lines; Slot line and Coupled lines; Design of power dividers and combiners, directional couplers, hybrid couplers, filters.
Microstrip lines on ferrite and garnet substrates; Isolators and circulators; Lumped elements in MICs.
Technology of MICs: Monolithic and hybrid substrates; thin and thick film technologies, computer aided design.

Texts/References

1) Leo Young and H. Sobol, Ed. Advances in Microwaves, Vol.2, Academic Press Inc., 1974.
2) B.Bhat and S. Koul, Stripline-like transmission lines for MICs, John Wiley, 1989.
3) T.K. Ishii, Handbook of Microwave Technology

5. Information theory and coding

Mutual information, entropy for discrete ensembles; Shannon's noiseless coding theorem; Encoding of discrete sources.
Markov sources; Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.Techniques of coding and decoding; Huffman codes and uniquely detectable codes; Cyclic codes, convolutional arithmetic codes.

Texts/References

1) N. Abramson, Information and Coding, McGraw Hill, 1963.
2) M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.
3) R.B. Ash, Information Theory, Prentice Hall, 1970.
4) Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.

6.Microwave Lab

7. Biomedical Lab

SEMESTER 3

a) Optical computing

Basic elements of optical systems- mirrors, gratings, lenses. Transducers- spatial light modulators, Holographic elements, Fundamental Limitations on dynamic range, Hybrid optical electronics systems, Dependence between optics and electronics.Image spectral analysis and filtering, pattern recognitions Picture deblurring –synthetic aperture Radar imaging. Radio signal analysis-simple arithmetic, matrix operation- Differential and integration
Non –linear effects- optical bistability, Hybrid polarisation devices, optical phase conjugation. Passive and Active integrated optic devices
Digital optical computers – Internal representation, implementation of binary logic elements, implementation of arithmetic units.
Memory – interconnection and communication –Architectures

Texts/References

1) Optical Computing: An Introduction by Mohammad A. Karim, Abdul A. S. Awwal
2) A Digital Design Methodology for Optical Computing by Miles Murdocca
3) Introduction to Fourier Optics by Joseph W. Goodman
4) Feitelson, D. G., Optical Computing: A Survey for Computer Scientists., (ISBN 0-262-061-120), MIT Press 1988.

b) RF Microelectronic chip design:

Introduction to RF and Wireless Technology: Complexity, design and applications. Choice of Technology. Basic concepts in RF Design: Nonlinearly and Time Variance, intersymbol Interference, random processes and Noise. Definitions of sensitivity and dynamic range, conversion Gains and Distortion. Analog and Digital Modulation for RF circuits: Comparison of various techniques for power efficiency. Coherent and Non coherent defection. Mobile RF Communication systems and basics of Multiple Access techniques. Receiver and Transmitter Architectures and Testing heterodyne, Homodyne, Image-reject, Direct-IF and sub-sampled receivers. Direct Conversion and two steps transmitters. BJT and MOSFET behavior at RF frequencies Modeling of the transistors and SPICE models. Noise performance and limitation of devices. Integrated Parasitic elements at high frequencies and their monolithic implementation. Basic blocks in RF systems and their VLSI implementation : Low Noise Amplifiers design in various technologies, Design of Mixers at GHz frequency range. Various Mixers, their working and implementations, Oscillators: Basic topologies VCO and definition of phase noise. Noise-Power trade-off. Resonatorless VCO design. Quadrature and single-sideband generators, Radio Frequency Synthesizes: PLLS, Various RF synthesizer architectures and frequency dividers, Power Amplifiers design. Linearisation techniques, Design issues in integrated RF filters. CAD tools for RF VLSI designs.

Texts/References

1) B.Razavi, RF Microelectronics, Prentice-Hall PTR,1998
2) T.H.Lee, The Design of CMOS Radio-Frequency Integrated Circuits", Cambridge University Press, 1998.
3) R.Jacob Baker,H.W.Li, and D.E. Boyce, CMOS Circuit Design ,Layout and Simulation, Prentice-Hall of India,1998.
4) Y.P. Tsividis Mixed Analog and Digital VLSI Devices and Technology, McGraw Hill,1996

c) Power electronics:

Review of line commutated converters, inverters, voltage control & Power factor improvement. power Devices : BJT, MOSFET, IGBT & GTOs - operating characteristics and gate drive requirements and circuits. Switched - mode rectifier: various Power circuit configurations & wave shaping techniques. Synchronous link rectifiers: Power circuit configurations, control techniques, application of these converters in load compensation, series compensators, multi level converters. inverters : voltage source inverters:- single phase & Six step inverters, voltage control & PWM strategies,and implementation aspects, Modification of power circuit for Four quadrant operation. Current source inverters: single phase and three phase power circuit configuration and analysis. Load commutated inverters: principle of operation, modification of power circuit configuration for low frequency operation. Phase Controllers.

Texts/References

1) N.Mohan,T.M. Undeland & W.P.Robbins, Power Electronics: Converter, Applications & Design, John Wiley & Sons, 1989.
2) M.H. Rashid, Power Electronics, Prentice Hall of India, 1994.
3) B.K.Bose, Power Electronics & A.C. Drives, Prentice Hall, 1986.
4) R. Bausiere & G. Seguier, Power Electronic Converters, Springer- Verlag, 1987.
5) D.M.Mitchell, DC-DC Switching Regulator Analysis McGraw Hill, 1987.

d) Embedded system design:

The concept of embedded systems design. Embedded microcontroller cores, embedded memories. Examples of embedded systems.

Technological aspects of embedded systems: interfacing between analog and digital blocks, signal conditioning, digital signal processing. sub-system interfacing, interfacing with external systems, user interfacing. Design trade offs due to process compatibility, thermal considerations, etc.

Software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

Texts/References

1) J.W. Valvano, "Embedded Microcomputor System: Real Time Interfacing", Brooks/Cole, 2000.
2) Jack Ganssle, "The Art of Designing Embedded Systems", Newnes, 1999.
3) V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
4) David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
5) K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.

e) Electronic system design:

Signal conditioning, instrumentation and isolation amplifiers, analog filters, analog switches, programmable circuits, switched- capacitor circuits and application. A/D and D/A conversion : sampling and quantisation, antialiasing and smoothening filters , data converters, interfacing with DSP blocks. Signal measurements in the presence of noise: synchronous detection, signal averaging .noise in electronic systems: design of low nise circuits. Interfacing of analog and digital systems. PCB design and layout; system assembly consideration.

Texts/References

1) S Sedra and KC Smith, Microelectronic circuits, Oxford, 1998.
2) S. Soclof, Applications of analog integrated circuits, Prentice Hall1990.
3) T. T. Lang, Electronics of measuring systems - practical implementation, Wiley,1987.
4) P. Horowitz and W Hill, The art of electronics, Cambridge,1995.
5) H.W.Ott, Noise Reduction Techniques in Electronic Systems, Wiley, 1989.
6) S. K Mitra, Digital signal processing: a computer based approach, McGraw Hill, 1998.
7) W.C. Bosshart, Printed Circuit Boards: Design and Technology, Tata McGraw Hill, 1983.
8) G.L. Ginsberg, Printed Circuit Design, McGraw Hill, 1991.

f) Advanced Optical Communication

Generations of Optical Fiber Links.

Description of a 8 Mbps Optical fiber communication link: System Architecture, System Technology, Hardware Architecture, Specifications, Types of LASERS used.

Description of a 2.5 Gbps Optical fiber communication link: Optical Transport Network Concept, Optical Cross-connect

Optical Networks: Optical Wavelength Division Multiplexing, Commercial WDM systems, Intelligent Optical internetworking, Architecture, Tunable transmitters and receivers, Optical Amplifier, Wavelength multiplexer/demultiplexer, Wavelength Routers, Wavelength Converters , Applications: Asynchronous Transmitter Mode (ATM) and Synchronous Optical Network(SONET).

Photonic Packet Switching: Synchronization of Networks, Unslotted Networks, Optical Buffering.

Wireless Optical Communication Systems: Wireless optical intensity channels, Introduction to optical intensity signalling, MIMO optical channels.

Texts/References:

1) Govind P. Agarwal: Fiber Optic Communication Systems, 2nd Edition (John Wiley)
2) Casimer DeCusatis: Fiber Optic Data Communication: Technological trends and advances (Academic Press)
3) Ajoy Ghatak and K. Thyagarajan: Optical Electronics: (Cambridge University Press)
4) Steve Hranilovic : Wireless Optical Communication Systems: Springer
5) Gerd Keiser: Optical fiber communication, McGraw Hill
6) Das : Optical Signal Processing, Springer – Verlag 1990
7) John Senior: Optical Fiber Communications, 2nd Edition Prentice Hall International

g) Sensors in instrumentation:

Sensor characteristics; R, L and C sensors: Hall effect sensors; Piezoelectric sensors; Micro-sensors. Sensors for displacement, pressure, temperature, flow etc. Optical sensors; chemical and bio-sensors. Sensor applications in non-destructive testing. Interfacing sensors with microprocessors and micro controllers.

Texts/References

1) D. V.S.Murthy,Transducers in instrumentation,Prentice Hall, 1995.
2) J. P.Bentley, Principles of measurement systems, Wiley,1989
3) J. W.Gardner, Microsensors, principles and applications, Wiley,1996.
4) S.M.Sze, Semiconductor Sensors, Wiley,1994

h) Simulation of circuits and devices

Formulation of network equations: Nodal, mesh, modified nodal and hybrid analysis equations.

Sparse matrix techniques; Solution of nonlinear networks through Newton-Raphson technique.

Multistep methods: convergence and stability; Special classes of multistep methods: Adams-bashforth, Adams-Moulton and Gear's methods; Solution of stiff systems of equations; Adaptation of multistep methods to the solution of electrical networks; General purpose circuit simulators.

Review of semiconductor equations (Poisson, continuity, drift-diffusion, trap rate). Finite difference formulation of these equations in 1D and 2D. Grid generation.

Physical/empirical models of semiconductor parameters (mobility, lifetime, band gap, etc.).

Computation of characteristics of simple devices (p-n junction, MOS capacitor, MOSFET, etc.); Small-signal analysis.

Texts/References

1) L.O.Chua and P.M.Lin, Computer aided analysis and electronic circuits, Prentice Hall, 1975.
2) S. Selberherr, Analysis and Simulation of Semiconductor Devices, Springer-Verlag, 1984.

3) N.J. McCalla, Fundamentals of Computer Aided Circuit Simulation, Kluwer Academic Publishers, 1988.

i) Image processing:

Image representation - Gray scale and colour Images, image sampling and quantization.
Two dimensional orthogonal 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, localisation 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.
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 communication - JPEG, MPEGs and H.26x standards, packet video, error concealment.
Image texture analysis - co-occurence matrix, measures of textures, statistical models for textures.
Misc. topics such as - Hough Transform, boundary detection, chain coding, and segmentation, thresholding methods.

Texts/References

1) A. K. Jain, Fundamentals of digital image processing, Prentice Hall of India, 1989.
2) R.M. Haralick, and L.G. Shapiro, Computer and Robot Vision, Vol-1, Addison Wesley, Reading, MA, 1992.
3) R. Jain, R. Kasturi and B.G. Schunck, Machine Vision, McGraw-Hill International Edition, 1995.
4) W. K. Pratt, Digital image processing, Prentice Hall, 1989.
   A. Rosenfold and A. C. Kak, Digital image processing, Vols. 1 and 2, Prentice Hall, 1986.
5) H. C. Andrew and B. R. Hunt, Digital image restoration, Prentice Hall, 1977

j) Error correcting codes

Linear block codes : Systematic linear codes and optimum decoding for the binary symmetric channel; Generator and Parity Check matrices, Syndrome decoding on symmetric channels; Hamming codes; Weight enumerators and the MacWilliams identities; Perfect codes.
Introduction to finite fields and finite rings; factorization of (X^n-1) over a finite field; Cyclic Codes.
BCH codes; Idempotents and Mattson-Solomon polynomials; Reed-Solomon codes, Justeen codes, MDS codes, Alterant, Goppa and generalized BCH codes; Spectral properties of cyclic codes.
Decoding of BCH codes: Berlekamp's decoding algorithm, Massey's minimum shift register synthesis technique and its relation to Berlekamp's algorithm. A fast Berlekamp - Massey algorithm.
Convolution codes; Wozencraft's sequential decoding algorithm, Fann's algorithm and other sequential decoding algorithms; Viterbi decoding algorithm.

Texts/References

1) F.J. MacWilliams and N.J.A. Slone, The theory of error correcting codes, North Holland, 1977.
2) R.E. Balahut, Theory and practice of error control codes, Addison Wesley, 1983.

k) Industrial design of electronic equipments:

Introduction to industrial design , product design methodology, product planning, data collection , creativity techniques, elements of aesthetics,. Ergonomics, control panel organization, graphic user interface, design structure, materials , processes and product finishers, product detailing anf value engineering

Texts/References

1) Industrial Design and Engg. Design council By Flurschiem CH (springer verlag)
2) Control Panel Design and Ergonomics By Yammiyavar (CEDT/IISC publication)

SEMESTER 4

Thesis work

Thesis work will start from the 3rd semester and will continue in the 4th semester.