TENTATIVE SYLLABUS

B.Tech. [Electronics and Communication Engineering]
Department of Electronics and Communication Engineering
National Institute of Technology Calicut
(2002 Admission onwards)
**MA201T MATHEMATICS III**

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**EE218T: ELECTRICAL TECHNOLOGY**

LGDP: Cr 3100:3

Electrical measurements-characteristics—Measurement of power, energy, resistance, inductance, magnetic field measurements, transformers, construction, principle of operation, single phase autotransformer, electromagnetic energy conversion, types of machines, construction, rotating magnetic field, principle of operation, electric machines, DC generator, DC motors, load characteristics, speed control, applications, Alternators, synchronous motors, three phase induction motors, principle, types, starting, load characteristics, speed control, applications, connections and applications of single phase motors.

**Text Books:**


**References Books:**


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**EC210T ELECTRIC CIRCUITS AND NETWORK THEORY**

LGDP: Cr 3100:3

**Module I (10 Hours)**

Network topologies - graph theoretic methods to formation of network equations - Review of network theorems - step response and impulse response of first and second order circuits

**Module II (10 Hours)**

Laplace transform method of network characterisation - impulse response and transfer function- poles and zeros - causality and stability

**Module III (10 Hours)**

Two port networks - relationships among parameter sets –T and Π equivalent of a two port network – constant k and m-derived filter sections

**Module IV (9 Hours)**

Network synthesis - Foster and Cauer forms of RC and RL networks

**Text Books**

2. Van Valkenberg: Network Analysis, Prentice Hall of India
4. Reference Books:
   1. Franklin F. Kuo: Network Analysis and Synthesis, John Wiley and sons

EC211T SOLID STATE DEVICES
LGDP: Cr 3100:3

Module I

Module II
Intrinsic and semiconductors – scattering mechanisms – drift and diffusion processes – excess carrier phenomena in semiconductors

Module III
p-n junctions – I/V characteristics – breakdown mechanisms – metal semiconductor junctions – tunnel diodes

Module IV
Bipolar junction transistors – non ideal effects – BJT models – HBTs – JFETs – MOSFETs

Text Books:
1. ‘Solid state devices’, Ben G Streetman , 5e, 2002, Pearson Education

References:
2. ‘Semiconductor physical electronics’, Sheng. S.Li, plenum press, 1993

EC230T DIGITAL ELECTRONICS
LGDP: Cr 3100:3

Module I (8 Hours)
Review of number systems and Boolean algebra – Simplification methods - Combinational logic design– Arithmetic circuits

Module II (12 Hours)
Sequential circuits –Design and analysis of sequential circuits –Analysis of sequential networks – sequential network design

Module III (8 Hours)
Memory, CPLD and FPGAs - Architecture

Module IV (11 Hours)
Logic families - TTL and CMOS - Interfacing BJT and CMOS gates

Text Books
2. Roth C H: Fundamentals of Logic Design, Jaico Pub
Reference Books:

2. Lewin D & Protheroe D: Design of Logic Systems, Chapman & Hall

EC250T SIGNALS & SYSTEMS

Module I
Signals and systems – Operations on signals- Properties of - Impulse response - Representation of LTI systems

Module II (12 hours)
Fourier representation of continuous time signals - Frequency response of LTI systems - Sampling and reconstruction.

Module III (11 hours)
Fourier representation of discrete time signals - Laplace transform analysis of systems - Causality and stability - Inverse system.

Module IV (10 hours)
Z Transform - Analysis of LTI systems - Determining the frequency response from poles and zeros.

Text books


Reference books


EC212L BASIC ELECTRONICS ENGINEERING LAB

1. Electronics Workshop - I
2. Electronics Workshop - II
3. Electronics Workshop - III
4. Diode & Zener diode characteristics - dc and dynamic resistance
5. Clipping and Clamping circuits.
6. Zener diode regulator - regulation curves
7. Half wave rectifier with C, LC & CRC filters
8. Full wave rectifiers with C, LC & CRC filters
9. CB configuration - determination of h parameters
10. CE configuration - determination of h parameters
11. JFET Characteristics.
12. UJT Characteristics and Relaxation Oscillator.
13. Series resonant and parallel resonant circuits - voltage and current amplification

EC219L ELECTRICAL ENGINEERING LAB
LGDP: Cr 0003:1

**NA****
MA202T MATHEMATICS IV

EC213T ELECTROMAGNETIC FIELD THEORY

**Mod.1: Electrostatics (10 hours)**: Coulomb’s law, electric field, flux and Gauss’s law, curl and divergence of electrostatic fields, electric potential, Poisson’s equation, Laplace’s equation, solutions to electrostatic boundary problems, method of images, work and energy in electrostatics, induced dipoles and polarization, field inside a dielectric, electric displacement, concepts of susceptibility, permittivity and dielectric constant, boundary condition ions, capacitors, surface charge and induced charge on conductors.

**Mod.2: Magnetostatics (9 hours)**: Lorentz force, Biot-Savart law, magnetic flux density, divergence and curl of flux density, Ampere’s law, magnetic vector potential, magnetization, torque and force on magnetic dipoles, boundary conditions, magnetic susceptibility and permeability.

**Mod.3: Electrodynamics (9 hours)**: Electromagnetic induction, inductance, displacement current, Maxwell’s equations, boundary conditions, Poynting’s theorem, energy and momentum in electromagnetic field.

**Mod.4: Electromagnetic Waves (11 hours)**: EM waves in vacuum and in matter, monochromatic plane waves, reflection and transmission at interfaces, scalar and vector potentials, Lorentz gauge, retarded potentials. Transmission lines: Quasi-TEM analysis, characteristic impedance, standing wave ratio, matching techniques.

**Reference**:
1. David J Griffiths: Introduction to Electrodynamics, Third edition, PHI.

EC220T PULSE CIRCUITS

**Module 1 (10 hours)**
RC circuit as integrator and differentiator – Compensated attenuators – Pulse transformer-Switching characteristics of a BJT – BJT switches with inductive and capacitive loads – emitter follower with capacitive loading - Switching characteristics of a MOS inverter – resistive load & active load configurations – CMOS inverter – dynamic power dissipation

**Module 2 (10 hours)**
Bistable, monostable and astable multivibrators – collector coupled monoshot – emitter coupled monoshot – triggering the monoshot – collector coupled and emitter coupled astable multivibrator - Astable, monostable and bistable operations using negative resistance devices – Multivibrators with 555 IC timer

**Module 3 (9 hours)**
General features of a time base signal and exponential sweep circuits - voltage and current time base generators –Miller & bootstrap sweep generator configurations – methods to
improve linearity Digital Phase Locked Loops – Parameters of PLL: Phase detectors (XOR & phase frequency detectors) – Loop filter - Analysis of PLL - typical applications of PLL

**Module 4 (10 hours)**

Digital to analog converters – Accuracy, resolution, conversion speed, offset error, gain error, integral and differential nonlinearity of data converters - R-2R ladder, binary weighted, current steering, charge scaling, cyclic & pipeline DACs Analog to digital converters – track and hold operation - flash converter, two step flash, pipeline, integrating, staircase converter, successive approximation converter, dual slope & oversampling ADCs – Principle of Sigma-delta ADC.

**Text books:**
1. Jacob Millman & Herbert Taub: Pulse, Digital & Switching Waveforms, TMGH

**Reference books**
1. Taub & Schilling: Digital Integrated Electronics, MGH.
2. A S Sedra & K C Smith: Microelectronic Circuits, Oxford University Press

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**EC221T ELECTRONICS CIRCUITS**

**LGDP: Cr 3100:3**

**Mod.1: BJT amplifiers (10 hours):** Biasing schemes, load line concept, bias stabilization, stability factor, bias compensation, analyses and design of CC, CE and CB configurations, RC coupled and transformer coupled multistage amplifiers, frequency response of amplifiers – thermal runaway in BJT amplifiers.

**Mod.2: FET amplifiers (10 hours):** Biasing of JFET – self bias and fixed bias, biasing of MOSFETs – feedback biasing and fixed biasing for enhancement and depletion mode MOSFETs, analyses and design of common source, common drain and common gate amplifier configurations – thermal runaway in MOS amplifiers.

**Mod.3: Feedback (10 hours)** – Effect of feedback on amplifier performance, voltage shunt, voltage series, current series and current shunt feedback configurations, concept of stability, Nyquist criterion.

**Oscillators** – conditions for oscillations - analysis of RC phase shift, Colpitts, Hartley and crystal oscillators.

**Mod.4: Power amplifiers (9 hours)** – Class A, B, AB, C, D & S switching power amplifiers – harmonic distortion, efficiency, relative performance. Wide band amplifiers – Broad banding techniques, low frequency and high frequency compensation, CC-CE cascade, cascode amplifier, broadbanding using inductors.

**Text Book:**

**References:**
1. Millman & Halkias : `Integrated Electronics’, MGH.

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**EC231T MICROPROCESSORS & MICROCONTROLLERS**

**LGDP: Cr 3100:3**

**Module I (8 hours)**

Basic ideas of computer architecture-Design ideology of CPU and control unit-CPU Memory Interaction-memory address mapping techniques

**Module II (12 hours)**
Module III (9 hours)
Introduction to 80286 – Memory management unit- descriptors, selectors description tables and TSS – real and protected mode- Memory paging features of the Pentium processor – Branch prediction logic - Superscalar architecture.-PCI bus

Module IV (10 hours)
Intel 8051 microcontroller –architecture –ports ,timers, interrupts, serial data transmission instruction set -programming

Text Books
1. Hall D V , Microprocessors & Interfacing , McGraw Hill

Reference Books
1. Intel Data Book Vol.1 , Embedded Microcontrollers and Processors

EC240T ANALOG COMMUNICATIONS

Module 1 (9 Hours)

Module 2 (8 Hours)

Module 3 (11 Hours)

Module 4 (11 Hours)

Textbooks recommended

References
4. Tomasi: Electronic communication: Fundamentals through advanced, Pearson Education
5. Couch: Digital and Analog Communication Systems, Pearson Education

EC222L ELECTRONICS CIRCUITS LABORATORY

1. Feedback voltage regulator with short circuit protection.
2. Emitter follower with & without complementary transistors – Frequency and phase response driving a capacitive load.
3. Single stage BJT/FET amplifier
4. 2 stage RC coupled amplifier – Frequency response
5. Cascode amplifier – Frequency response
6. Phase shift oscillator using BJT/FET.
7. Hartley/Colpitts oscillator using BJT/FET.
8. Power amplifier – Class A & class AB.
10. Tuned amplifier

EC232L DIGITAL ELECTRONICS LABORATORY

List of experiments
1. Characteristics of TTL gates
2. Code converters and parity circuits using basic gates
3. Combinational logic design using Decoders and MUXs
4. Half and Full adders and subtractors
5. 4 bit adder-subtractor IC & BCD adder circuit
6. Flip flop circuit (RS latch, JK and Master Slave) using basic gates
7. Ripple, Johnson and Ring counters
8. Synchronous Counters and pseudorandom sequence generators
9. State machine for sequence detection
10. Astable and Monostable circuits using gates and timer IC
11. DAC Circuits (ladder and weighted resistor) and ICs
12. ADC Circuits (eg. counter ramp) and ICs
SEMESTER V

ZZ301T ENVIRONMENTAL STUDIES
**********NA************

EC316T CONTROL SYSTEMS ENGINEERING
LGDP: Cr 3100:3

Module I (10 hours)
General schematic diagram of control systems - open loop and closed loop systems - concept of feedback - modeling of continuous time systems - Laplace transform - properties - application in solution of differential equations - transfer function - block diagrams - signal flow graph - mason's gain formula - block diagram reduction using direct techniques and signal flow graphs - examples - derivation of transfer function of simple systems from physical relations - low pass RC filter - RLC series network - spring mass damper - low pass active filter - definitions of poles, zeros, order and type

Module II (10 hours)
Analysis of continuous time systems - time domain solution of first order systems - time constant - time domain solution of second order systems - determination of response for standard inputs using transfer functions - steady state error - concept of stability - Routh-Hurwitz techniques - construction of bode diagrams - phase margin - gain margin - construction of root locus - polar plots and theory of nyquist criterion - theory of lag - lead and lag-lead compensators

Module III (10 hours)
Modeling of discrete-time systems - sampling - mathematical derivations for sampling - sample and hold - Z-transforms-properties - solution of difference equations using Z-transforms - examples of sampled data systems - mapping between s plane and z plane - cyclic and multi-rate sampling (definitions only) - analysis of discrete time systems - pulse transfer function - examples - stability - Jury's criterion - bilinear transformation - stability analysis after bilinear transformation - Routh-Hurwitz techniques - construction of bode diagrams - phase margin - gain margin - digital redesign of continuous time systems

Module IV (9 hours)
State variable methods - introduction to the state variable concept - state space models - physical variable - phase variable and diagonal forms from time domain (up to third order only) - diagonalisation - solution of state equations - homogenous and non homogenous cases (up to second order only) - properties of state transition matrix - state space representation of discrete time systems - solution techniques - relation between transfer function and state space models for continuous and discrete cases - relation between poles and Eigen values

Reference books
2. Ogata K., "Modern Control Engineering", Prentice Hall India
EC320T LINEAR INTEGRATED CIRCUITS
LGDP: Cr 3100:3

Module I (10 hours)

Module II (8 hours)
MOS differential amplifier - current mirrors - current source load and cascode loads - wide swing constant transconductance differential amplifier - CMOS opamp with and without compensation - cascode input opamp - typical CMOS opamp parameters

Module III (11 hours)
Linear opamp circuits - inverting and noninverting configurations - analysis for closed loop gain - input and output impedances - virtual short concept - current to voltage and voltage to current converters - instrumentation amplifier - nonlinear opamp circuits - log and antilog amplifiers - 4 quadrant multipliers and dividers - phase shift and wein bridge oscillators - comparators - astable and monostable circuits - linear sweep circuits

Module IV (10 hours)
Butterworth approximation to ideal low pass filter characteristics – features of Chebychev and Bessel approximations - frequency transformations to obtain HPF, BPF and BEF from normalized prototype LPF – Realization of LPF & HPF using Sallen-Key configuration - BPF realization using the Delyannis configuration - BEF using twin T configuration - all pass filter (first & second orders) realizations - inductance simulation using Antoniou’s gyrator.

Text books
4. Gaykward, Operational Amplifiers, Pearson Education

Reference books

EC340T DIGITAL COMMUNICATIONS
LGDP: Cr 3100:3

Module I (9 hrs.)
Analog Pulse Modulation: Sampling theorem for band-pass signals, Pulse Amplitude modulation: generation and demodulation, PAM/TDM system, PPM generation and demodulation, PWM, Spectra of Pulse modulated signals, SNR calculations for pulse modulation systems.
Waveform coding: quantization, PCM, DPCM, Delta modulation, Adaptive delta modulation- Design of typical systems and performance analysis.

**Module II ( 8 hrs.)**
Pulse Shaping, Nyquist criterion for zero ISI, Signalling with duobinary pulses, Eye diagram, Equalizer, Scrambling and descrambling.
Signal space concepts: geometric structure of the signal space, $L^2$ space, distance, norm and inner product, orthogonality.- Base band pulse data transmission: Matched filter receiver, Inter symbol interference, Gram-Schmidt Orthogonalization Procedure.

**Module III (10 hrs)**
Review of Gaussian random process, Optimum threshold detection, Optimum Receiver for AWGN channel, Matched filter and Correlation receivers, Decision Procedure: Maximum a-posteriori probability detector- Maximum likelihood Detector, Probability of error, Bit error rate.

**Module IV (12 hrs.)**
Digital modulation schemes:
Coherent Binary Schemes : ASK, FSK, PSK, MSK. Coherent M-ary Schemes, Calculation of average probability of error for different modulation schemes, Power spectra of digitally modulated signals, Performance comparison of different digital modulation schemes.

**Text books:**


**References:**

1. Digital and Analog Communication Systems, K.Sam Shanmugham, John Wiley & Sons

**EC350T DIGITAL SIGNAL PROCESSING**

LGDP: Cr 3100:3

**Module I: Discrete Fourier transform (10 hours)**
Discrete Fourier series - properties of DFS - periodic convolution - DFT - properties - linear convolution using DFT - computation of DFT - circular convolution - decimation in time and decimation in frequency algorithms - FFT algorithm for a composite number

**Module II: IIR and FIR Filter structures (8 hours)**
Signal flow graph representation - basic filter structures - structures for linear phase - finite word - length effects in digital filters - quantizer characteristics - saturation overflow - quantisation in implementing systems - zero Input limit cycles

**Module III: Digital filter design (12 hours)**
Design of IIR digital filters from analog filters - Butterworth and Chebyshev filters - design examples - impulse invariant and bilinear transformation methods - spectral transformation of IIR filters - FIR filter design - linear phase characteristics - window method

**Module IV: General and special purpose hardware for DSP (9 hours)**
Computer architecture for signal processing - hardware architecture - pipelining - hardware multiplier - accumulator - special instructions - general purpose digital signal processors - texas instruments - TMS 320 family - motorola DSP 56000 family - analog devices ADSP 2100 family - implementation of DSP algorithm on general purpose digital signal processors

**Reference books**


**EC330L MICROPROCESSORS AND MICROCONTROLLERS LAB**

LGDP: Cr 0003:1

1. Assembly language programming of 8086
   a) Sorting , code conversion, Pascal’s triangle
   b) Matrix multiplication
   c) TSR programming  [3 classes]
2. Interfacing experiments of 8086
   a) Stepper motor interface
   b) Display card interface
   c) Hex key board interface
   d) Parallel port interface
   e) ADC/DAC interface  [5 classes]
3. Assembly language programming of the 8051  [1 class]
4. Interfacing experiments of 8051
   a) Parallel port and serial port interface
   b) Counter and Timer interface  [2 classes]

**EC341L ANALOG COMMUNICATION LAB**

LGDP: Cr 0003:1

1. AM generation
2. AM detection with simple and delayed AGC
3. RF Mixer using JFET/BJT
4. FM generation (reactance modulator)
5. FM demodulation
6. PAM generation and demodulation
7. Generation and demodulation of PWM and PPM
8. Implementation of intermediate frequency amplifier
9. PLL characteristics and demodulation using PLL
10. SSB generation and demodulation using integrated circuits
Electives

EC315T ELECTRONIC INSTRUMENTATION
LGDP: Cr 3100:3

Module I: (10 hours)

Module II: (9 hours)

Module III: (10 hours)

Module III: (10 hours)

Text Books

References
3. George C. Barney - Intelligent Instrumentation – Prentice Hall India

EC335T COMPUTER ORGANISATION AND ARCHITECTURE
LGDP: Cr 3100:3

Module 1 (10 Hours)

Module 2 (10 Hours)

Module 3 (10 Hours)
**Advanced CPU Organization:** RISC Processors – RISC Architecture _ RISC Pipelining – Typical RISC Processors – Super scalar Processing – Typical Super scalar Processors – Control Unit issues – Micro programmed Control

**Module 4 (9 Hours)**

**Parallel Processing:** Multiprocessing – Clusters and Network Topologies - Cache Coherence _ Vector Computation – Parallel Processors

**Textbooks Recommended**


**EC336T DIGITAL SYSTEM DESIGN**

LGDП: Cr 3100:3

**Module 1 (9 Hours)**


**Module 2 (9 Hours)**

**Advanced VHDL features:** Generics and Configurations – Subprograms and Overloading – Packages and Libraries – Advanced features – simulation semantics – modelling examples – state machine modelling using VHDL- review of FPGA architectures and design using FPGA

**Module 3 (11 Hours)**


**Module 4 (10 Hours)**

Design for Testability: Ad-hoc design for testability techniques – Classical scan designs – Boundary scan standards – Built-in-self-test – Test pattern generation – BIST architecture examples

**Textbooks Recommended**

1. J. Bhasker; A VHDL Primer, Addison-Wesley, Third Edition
2. J. Bhasker; A VHDL Synthesis Primer, B.S. Publications 2001
ME301T PRINCIPLES OF MANAGEMENT
*********NA************

EC321T MICROWAVE DEVICES AND CIRCUITS

LGDP: Cr 3100:3

Module I: Passive microwave devices (10 hours): Analysis of rectangular and circular waveguides and resonators, TE and TM modes, Q of the cavity, loss mechanisms, scattering matrix, directional coupler, waveguide tees, hybrid couplers, Faraday rotation in ferrites, isolator, circulator. Passive microwave circuits: Microstrip and stripline, filter implementation with transmission lines and strip lines

Module II: Microwave tube amplifiers (10 hours): Klystron – velocity modulation and bunching, Travelling wave tube – slow wave structure and Brillouin diagram. Maser – population inversion, pumping and stimulated emission

Module III: Microwave semiconductor amplifiers (10 hours): BJT, MESFET, tunnel diode, parametric amplifiers – Principle and analysis of amplifier configurations and parameters like gain, bandwidth, noise figure, dynamic range - Single stage and broad band transistor amplifier designs - stability

Module IV: Microwave oscillators (9 hours): Reflex klystron, magnetron, Gunn diode, IMPATT and TRAPPAT diodes, parametric oscillators – Principle and analysis of oscillator configurations, efficiency, tunability.

Reference:
1. Rajeshwari Chatterji: Microwave, Millimeter wave and sub-millimeter wave vacuum electron devices, Affiliated East - West Press
2. R E Collin: Foundations for Microwave Engineering, IEEE.
5. P A Rizzi: Microwave Engineering, Prentice Hall.
9. Liao S.Y. Microwave Devices and Circuits, PHI

EC331T DIGITAL MOS CIRCUITS

LGDP: Cr 3100:3

Module I

Review of the basics physics and characteristics of MOS transistors –I-V & C-V characteristics - Short channel and narrow channel effects in MOSFETs - subthreshold conduction - channel length modulation - drain induced barrier lowering - hot carrier effects - velocity saturation of charge carriers etc. Scaling in MOSFETs – constant voltage and constant field scaling - digital MOSFET model - series connection of MOSFETs – body effect. Scaling issues in interconnects.Latch up in CMOS and methods for preventing latch up.

Module II

MOS inverters - resistive load - NMOS load - pseudo NMOS and CMOS inverters - calculation of input high and low and output high and low levels - power dissipation -
calculation of delay times for CMOS inverter - CMOS ring oscillator - design of super buffer - estimation of interconnect parasitics and calculation of interconnect delay. Static CMOS logic circuits - CMOS NOR, NAND, AOI and OAI gates - full adder - SR and JK latches - C²MOS latch - Pass transistors and Transmission gates - simple circuits using TG - basic principles of pass transistor logic - voltage boot strapping -

Module III

Pseudo NMOS – Tri-state circuits – clocked CMOS – Dynamic CMOS circuits – solutions for charge sharing - DOMINO Logic- NORA – TSPC logic styles – Dual rail logic networks – Implementation of general VLSI system components such as decoders, encoders, Flip Flops and Registers. Method of Logical Effort for high speed CMOS design - BiCMOS logic circuits - BiCMOS inverter with resistive base pull down and active base pull down - BiCMOS switching transients - simple gates using BiCMOS – Advanced CMOS logic styles –

Module IV

CMOS clocking styles- clock generation and distribution - Arithmatic Circuits in CMOS VLSI - high speed adders, subtractors and multipliers – CMOS Memory structures – SRAM and DRAM design –Sense amplifier design - Low power design techniques –MT CMOS – VTCMOS basic ideas of adiabatic logic. Floor planning and Routing – Input and Output circuits – special CMOS device structures such as SOI, DTMOS, Radiation Hard CMOS, Fin FETs, etc.

Reference Books:


EC342T INFORMATION THEORY & CODING

LGDP: Cr 3100:3

Module I (12 hours)

Information theory - information and entropy - properties of entropy of a binary memoryless source - extension of a binary memoryless source - source coding theorem - Shannon fano coding - Huffman coding – Lempel-Ziv coding - binary symmetric channel - mutual information - properties - channel capacity - channel coding theorem

Module II (9 hours)

Coding - linear block codes - generator matrices - parity check matrices - encoder - syndrome and error correction - minimum distance - error correction and error detection capabilities - cyclic codes - coding and decoding

Module III (9 hours)

Introduction to algebra - groups - fields - binary field arithmetic - construction of Galois field - basic properties - computations - vector spaces - matrices - BCH codes - description - decoding - Reed Solomon codes

Module IV (9 hours)
Coding - Convolutional codes - encoder - generator matrix - state diagram - distance properties - maximum likelihood decoding - viterbi decoding - sequential decoding

**Text books**


**Reference books**

1. Simon Haykin, *Digital Communications*, John Wiley

**EC322L LINEAR INTEGRATED CIRCUITS LAB.**

LGDP: Cr 0003:1

1. Measurement of op-amp parameters - CMRR, slew rate, open loop gain, input and output impedances
2. Inverting and non-inverting amplifiers, integrators and differentiators - frequency response
3. Instrumentation amplifier - gain, CMRR and input impedance
4. Single op-amp second order LPF and HPF - Sallen-Key configuration
5. Narrow band active BPF - Delyiannis configuration
6. Active notch filter realization using op-amps
7. Wein bridge oscillator with amplitude stabilization
8. RC phase shift oscillator
9. Astable and monostable multivibrators using op-amps
10. Square, triangular and ramp generation using op-amps
11. Astable and monostable multivibrators using IC 555
12. Linear sweep generation using IC 555
13. Design of PLL for given lock and capture ranges & frequency multiplication
14. Precision limiters using op-amps
15. Log and Antilog Amplifiers

**EC343L ADVANCED COMMUNICATION ENGG. LAB.**

LGDP: Cr 0003:1

**Microwave and Optical Experiments**

1. Klystron characteristics o/p power & frequency versus repeller voltage
2. Slotted line measurements. VSWR & Impedance
3. Antenna radiation pattern measurements
4. Directional coupler and isolator
5. Optical fibre experiments. Analog & digital

**Hardware Experiments**
1. PN and Orthogonal code generators
2. Digital TDM
3. Cyclic encoder and decoder
4. Spreader and de-spreaders for CDMA

**EC 390P: MINI PROJECT INDUSTRIAL TRAINING**

Prior to registration to 7th Semester all students have to complete a Mini Project/Industrial training. Only one will be credited if a student completes both mini project and industrial training.

**EC390P: Mini Project.** The mini project should be on Hardware Design and/or Fabrication in any of the areas in Electronics and Communication Engineering. Microcontroller/DSP/PLD based hardware design is also permitted. Project work can be carried out individually or by a group of maximum of four students under the guidance of a faculty from ECE Department. A committee of the faculty will evaluate the projects during the sixth semester. This course is normally engaged by the department at the beginning of sixth semester.

**EC390P: Industrial Training.** Industrial training shall be as per the institute norms from the list of firms approved by the department. The duration of the training must not be less than 4 weeks in a stretch. The Department of Training and Placement shall arrange for the same in consultation with the ECE department to satisfy specific requirements if any. Also the Department of Training and Placement will conduct evaluation and forward the result to ECE department.

**Electives**

**EC325T  IC TECHNOLOGY**

**Module I**

**Module II**
Module III

Module IV

References:

2. S.M.Sze, ‘ULSI Technology’, McGraw Hill

EC345T MICROWAVE COMMUNICATION

Module I : Satellite orbits (9 hours)
Orbital parameters, satellite trajectory, period, geostationary satellites, non-geostationary constellations. Communication satellites – Space craft subsystems, payload – repeater, antenna, attitude and control systems, telemetry, tracking and command, power sub system and thermal control.

Module II : Earth stations (9 hours)
Antenna and feed systems, satellite tracking system, amplifiers, fixed and mobile satellite service earth stations. Terrestrial: line of sight transmission, relay towers and distance considerations

Module III : Communication link design (10 hours)
Frequency bands used, antenna parameters, transmission equations, noise considerations, link design, propagation characteristics of fixed and mobile satellite links, channel modelling, very small aperture terminals (VSAT), VSAT design issues.

Module IV : Multiple access techniques (11 hours)
Frequency division multiple access, time division multiple access, code division multiple access.

Reference:
5. Ferdo Ivanek (Editor): ‘Terrestrial Digital Microwave Communications’, Artech House
Module 1:  Multirate system fundamentals.

Basic multirate operation – up-sampling and down sampling: Time domain and frequency domain analysis: Identities for multirate operations: Interpolator and decimator design: Rate conversion: Polyphase representation. (9 hours)

Module II:  Multirate Filter banks:


Module III:  M-channel perfect reconstruction filter banks:

Filter banks with equal pass band width, filter banks with unequal pass band width - Errors created by the filter banks system- aliasing and imaging, -Amplitude and phase distortion, polyphase representation- polyphes matrix. Perfect Reconstruction System- necessary and sufficient condition for perfect reconstruction , FIR PR Systems. Examples PR Systems. (10 hours)

Module IV: Linear phase perfect reconstruction (LPPR) filter banks: (10 hours)


Text Books:


Reference Books:


EC356T DIGITAL IMAGE PROCESSING

Module I Digital image representation:

Module I Digital image representation: (7 hrs.)
Basic functions in digital image processing; Image model; Sampling and quantization; Basic relationships between pixels; Basic geometric transformations; 2-D function representation; Separable functions; 2-D convolution; 2-D correlation.

**Module II Image transforms:** (8 hrs.)
2-D Discrete Fourier transform - properties; Walsh, Hadamard, Discrete Cosine, Haar and Slant transforms; The Hotelling transform.

**Module III Image enhancement:** (8 hrs.)
Spatial and frequency domain filtering methods; Histogram processing; Spatial mask generation; Colour image processing

**Module IV Image restoration:** (8 hrs.)
Degradation model; Circulant matrix formulation for complexity reduction; Algebraic methods; Inverse filtering; Wiener filter methods; Constrained least squares method of restoration.

**Module V Image compression:** (8 hrs.)
Fundamental concepts of image compression; Compression models; Information theoretic perspective; Fundamental coding theorem; lossy and lossless compression methods.

**Text Books:**


**Reference Books:**

SEMESTER VII

SH301T ECONOMICS
*********NA************

EC440T COMMUNICATION NETWORKS

LGDP: Cr 3100:3

Module I (15 Hrs)
Characteristics of Communication Networks- Traffic characterisation and Services- Circuit Switched and Packet Switched Networks- Virtual circuit Switched networks- OSI Model- Protocol Layers and Services- Data Link layer and services- Concept of LAN- Ethernet LAN- Ethernet frame structure- Address Resolution Protocol- IEEE 802.11 LAN’s- architecture and media access protocols- Error detection and correction at the Data link layer- Sliding Window protocols- analysis- Channel accessing protocols- Random accessing protocols.

Module II (12 Hrs)
Network layer and services- Shortest path length determination- Internet routing principles- Distance vector routing- Link state protocol- OSPF- - Router basics- Internet Protocol- IPV4 & IPV6- Transport Layer and services- Connectionless Transport- UDP- Services offered by UDP- Connection oriented Transport- TCP- addressing and multiplexing in TCP- TCP flow and congestion control.

Module III (13 Hrs)
Broadband services and ATM- Main features of ATM Networks- Statistical multiplexing- ATM reference model- Admission and Access control in Broadband networks- Analysis of Leaky Bucket Scheme- Broad band switches for ATM

Module IV (12 Hrs)

References:
1. Leon Garcia: “Communication networks, principles and architecture”, TMH
5. William Stallings: “High speed networks and internets, performance and Quality of Service” Pearson Education Asia

EC490S SEMINAR

LGDP: Cr 0003:1

Each student shall present a seminar in the seventh semester on a topic relevant to Electronics and Communication Engineering for about 30 minutes. The topic should not be a replica of what is contained in the syllabus. The topic shall be approved by the Seminar Evaluation Committee of the Department. The committee shall evaluate the presentation of students. A
seminar report in the prescribed form shall be submitted to the department after the approval from the committee.

**EC451L SIGNAL PROCESSING LAB.**

**Simulation Experiments** (using Mathlab/C) – Experiments involving concepts from FFT, Windowing Techniques, Aliasing Effects, Filter Design, DTMF Generation and Detection, Adaptive Processing, Multirate Processing and Echo Cancellation, Error Correction Coding, Modulation and Demodulation and Line Coding with Carrier recovery

**Hardware Experiments** (using assembly/C/Mathlab interface to DSP kit (TMS 320C6711 or similar. Application oriented Experiments like FSK, DPSK, Modem and Signal Compression Algorithms

**EC491P MAJOR PROJECT**

LGDP: Cr 0003:3

The duration of major project is for two continuous semesters from seventh. The project can be analytical work, simulation, hardware design or a combination of these in the emerging areas of Electronics and Communication Engineering under the supervision of a faculty from the ECE Department. Project work can be carried out individually or by a group of maximum of four students. The UG evaluation committee of the department shall evaluate the project during seventh semester for 3 of total of 8 credits assigned for the project.

**Electives**

**EC415T RADIATION AND PROPAGATION**

LGDP: Cr 3100:3

**Module I** : Potentials and radiation fields (11 hours): Retarded potentials, Lienard - Wiechert potentials for a moving charge, fields of a moving point charge, electric dipole radiation, magnetic dipole radiation, radiation from an arbitrary source, power radiated by a point charge, radiation reaction

**Module II** : Antenna parameters (9 hours): Directivity, gain, radiation resistance, beam width, input impedance, antenna noise and temperature, radiation pattern. Antennas: Dipole and monopole antennas, linear dipole arrays, loop antenna, helical antenna, Yagi - Uda antenna, parabolic antenna, Cassegrain antenna

**Module III** : Design of linear array antennas (8 hours): Dolph - Tchebycheff design, binomial design, Fourier transform based design

**Module II** : Propagation (11 hours): Effect of earth’s conductivity on antenna pattern, effect of earth’s conductivity and shape on surface wave propagation, effect of earth’s magnetic field on EM waves in ionosphere, plasma and cyclotron frequencies, skip distance, maximum usable frequency

**Reference:**

2. J D Krauss: Antennas, MGH
3. David J Griffiths: Introduction to Electrodynamics, Third edition, PHI
4. Jordan and Balmain: Electromagnetic waves and radiating systems, PHI
EC425T ANALOG MOS CIRCUITS

Module I (11 hours)
Analog MOS models - low frequency model - MOS in saturation - high frequency model - variation of transconductance with frequency - temperature effects in MOST - noise in MOST (shot, flicker and thermal noise) - MOS resistors and resistor circuits - super MOST

Module II (14 hours)
Current sources and sinks - current mirror - cascode current source - transient response of simple current mirror - Wilson current mirror - regulated cascode current source/sink - voltage references - resistor MOSFET and MOSFET only voltage references - band gap references - various biasing schemes for voltage references

Module III (12 hours)
Common source - common gate and source follower amplifiers - class AB amplifier - active load configuration - transimpedance amplifier - cascode amplifier - push pull amplifier - amplifier based signal processing - the differential difference amplifier (DDA) - adder, multiplier, divider and filters using DDA

Module IV (15 hours)
Mixed signal circuits - CMOS comparator design - pre amplification - decision and post amplification stages - transient response - clocked comparators - analog multiplier - the multiplying quad - level shifting in multipliers - dynamic analog circuits - charge injection and capacitive feed through in MOS switch - sample and hold circuits - switched capacitor filters - switched capacitor implementation of ladder filters

Reference books
2. Mohammed Ismail & Terri Fiez, Analog VLSI - Signal & Information Processing, MGH

EC426T ACTIVE NETWORK SYNTHESIS

Module I : Filter approximations (9 hours): Butterworth, Chebychev, Bessel and Elliptic approximations to ideal low pass filter characteristics – Frequency transformations to obtain HPF, BPF and BEF from normalized prototype LPF – Delay equalizer

Module II : Active biquad filters (9 hours): Active and passive sensitivities, LPF & HPF using Sallen-Key configuration, BPF realization using the Deliyannis configuration, BEF using twin T configuration, all pass filter realizations, KHN and Tow-Thomas configurations, Inductance simulation, Antoniou’s gyrator, filter realizations with gyrator

Module III : Effect of op-amp non-idealities (10 hours): Pole frequency and Q error problems – analysis with finite open loop gain of opamp, active and passive compensation, the Akerberg - Mossberg biquad

Module IV : Higher order filter realization (11 hours): Follow- the-leader structure, Cascade structure, Leap- frog structure, Circuit implementation and practical design considerations taking into account the input dynamic range and output signal-to-noise ratio.

Reference:

EC445T OPTICAL COMMUNICATION

Module I: Optical fiber fundamentals (12 hours)
Solution to Maxwell’s equation in a circularly symmetric step index optical fiber, linearly polarized modes, single mode and multimode fibers, concept of V number, graded index fibers, total number of guided modes (no derivation), polarization maintaining fibers, attenuation mechanisms in fibers, dispersion in single mode and multimode fibers, dispersion shifted and dispersion flattened fibers, attenuation and dispersion limits in fibers, Kerr nonlinearity, self phase modulation, combined effect of dispersion and self phase modulation, nonlinear Schrodinger equation (no derivation), fundamental soliton solution

Module II: Optical sources (8 hours)
LED and laser diode, principles of operation, concepts of line width, phase noise, switching and modulation characteristics – typical LED and LD structures.

Module III: Optical detectors (8 hours)
Pn detector, pin detector, avalanche photodiode – Principles of operation, concepts of responsivity, sensitivity and quantum efficiency, noise in detection, typical receiver configurations (high impedance and transimpedance receivers).

Module IV: Optical amplifiers (11 hours)
Semiconductor amplifier, rare earth doped fiber amplifier (with special reference to erbium doped fibers), Raman amplifier, Brillouin amplifier – principles of operation, amplifier noise, signal to noise ratio, gain, gain bandwidth, gain and noise dependencies, intermodulation effects, saturation induced crosstalk, wavelength range of operation.

Reference:
2. John Senior: ‘Optical Fiber Communications’, PHI.

EC455T WAVELETS

Module I (10 hours)
Fundamentals of signal decomposition - brief overview of Fourier transform and short term Fourier transform - introduction to wavelets - continuous wavelet transform - definition - CWT as a correlation - time frequency resolution

Module II (12 hours)
Introduction to the DWT and orthogonal wavelet decomposition - approximation of vectors in nested linear vector spaces - example of an MRA - orthogonal wavelet decomposition based on the Haar wavelet - digital filter implementation of the Haar wavelet decomposition (Mallat’s algorithm)

Module III (15 hours)
Construction of a general orthonormal MRA - formal definition - implication of the dilation equation and orthogonality - two scale relation for the wavelet function - digital filter implementation - reconstruction of the signal - introductory concepts of biorthogonal wavelet
basis and wavelet packets - two-dimensional wavelet decomposition - regularity - vanishing moments

**Module IV (15 hours)**
Applications - image compression - EZW algorithm - audio compression - signal denoising - edge detection - object isolation - image fusion - medical applications

**Text book**

**Reference books**

**EC456T SPEECH SIGNAL PROCESSING**
3 LGDP: Cr 3100:3

**Module I (15 hours)**

**Module II (15 hours)**
Spectral analysis of speech - short time fourier analysis - filter bank design - speech coding - subband coding of speech - transform coding - channel vocoder - formant vocoder - cepstral vocoder - vector quantizer coder

**Module III (12 hours)**
Speech synthesis - pitch extraction algorithms - gold rabiner pitch trackers - autocorrelation pitch trackers - voice/unvoiced detection - homomorphic speech processing - homomorphic systems for convolution - complex cepstrums - pitch extraction using homomorphic speech processing

**Module IV (10 hours)**
Automatic speech recognition systems - isolated word recognition - connected word recognition - large vocabulary word recognition systems - pattern classification - DTW, HMM - speaker recognition systems - speaker verification systems - speaker identification systems

**Text books**

**Reference books**
EC42T STATISTICAL COMMUNICATION THEORY
LGDP: Cr 3100:3

Module I
Introduction to Statistical Detection Theory- Binary decisions, single observation- Maximum likelihood decision criterion, Neymann- Pearson criterion, Minimum probability of error criterion, Baye’s Risk criterion- Receiver Operating characteristics.

Module II
Binary decisions with multiple observations- Vector observations- Waveform Observation- Detection of signals in additive Gaussian Noise- The correlation Receiver – The Matched Filter Receiver- Performance analysis.

Module III

Module IV

References:

EC492P MAJOR PROJECT
LGDP:Cr 0006:5

This is the continuation of project work by the students in the seventh semester. The UG evaluation committee of the department shall evaluate the project during eighth semester for 5 of total of 8 credits assigned for the project. A report of the project work carried out during the semester shall be submitted at the end of the semester approved by the HOD and project guide.

Electives
EC416T NONLINEAR SYSTEM ANALYSIS
LGDP:Cr 3100:3

Module I: State space concepts (11 hours):
Ordinary differential equation description of nonlinear state space systems, phase plane analysis, stable and unstable limit cycles, phase portraits, periodic orbits, Poincare sections, attractors and aperiodic attractors, KAM theorem, logistic maps and chaos, characterization of chaotic attractors, Benard-Rayleigh convection, Lorenz system
Module II: Concepts of stability (9 hours):
Lyapunov stability for autonomous and nonautonomous systems, the centre manifold theorem, La Salle theory, regions of attraction, invariance theorems, stability of perturbed systems for vanishing and nonvanishing perturbations, slowly varying systems, input-output stability.

Module III: Absolute stability (9 hours) –

Module IV: Nonlinear theory of oscillators (10 hours):
Pendulum equation with friction and nonlinearity, Van der Pol equation, stabilization of oscillations, attractors, basins and bifurcations of driven oscillators, global topology of the phase space.

Reference:

EC435T HIGH SPEED DIGITAL DESIGN

Module I (14 hours)
Introduction to high-speed digital design - frequency, time and distance - capacitance and inductance effects - high speed properties of logic gates - speed and power - measurement techniques - rise time and bandwidth of oscilloscope probes - self inductance, signal pickup and loading effects of probes - observing crosstalk

Module II (14 hours)
Transmission line effects and crosstalk - transmission lines - point to point wiring - infinite uniform transmission lines - effects of source and load impedance - special transmission line cases - line impedance and propagation delay - ground planes and layer stacking - crosstalk in solid ground planes, slotted ground planes and cross-hatched ground planes - near and far end crosstalk

Module III (12 hours)
Terminations and vias - terminations - end, source and middle terminations - AC biasing for end terminations - resistor selection - crosstalk in terminators - properties of vias - mechanical properties of vias - capacitance of vias - inductance of vias - return current and its relation to vias

Module IV (12 hours)
Stable reference voltage and clock distribution - stable voltage reference - distribution of uniform voltage - choosing a bypass capacitor - clock distribution - clock skew and methods to reduce skew - controlling crosstalk on clock lines - delay adjustments - clock oscillators and clock jitter

Text books
EC446T SATELLITE COMMUNICATION

Module I (13 hours)
Satellite orbits - solar day and sidereal day - orbital parameters - satellite trajectory - period, velocity and position of a satellite - geostationary satellites - non-geostationary constellations - launching of geostationary satellites - Hohmann transfer - effect of earth’s shape - other heavenly bodies - atmospheric drag and radiation pressure on the satellite’s orbit

Module II (13 hours)
Communication satellites - spacecraft subsystems - payload - repeater, antenna, attitude and control systems - telemetry, tracking and command - power sub system and thermal control
Earth stations - antenna and feed systems - satellite tracking system - amplifiers - fixed and mobile satellite service earth stations

Module III (13 hours)
Communication link design - frequency bands used - antenna parameters - transmission equations - noise considerations - link design - very small aperture terminals (VSAT) - VSAT design issues

Module IV (13 hours)
Multiple access techniques - frequency division multiple access - time division multiple access - code division multiple access - access protocols for data traffic

Reference books
11. Ha T.T., *Digital Satellite Communication*, MGH

EC447T WIRELESS & MOBILE COMMUNICATION

Module I (12 hours)
Mobile radio propagation - free space propagation model - ground reflection model - large scale path loss - small scale fading and multipath propagation - impulse response model of a multipath channel - parameters of a mobile multipath channel - multipath delay spread - doppler spread - coherence band width - coherence time - time dispersion and frequency selective fading - frequency dispersion and time selective fading - concepts of level crossing rate and average fade duration

Module II (14 hours)
Digital communication through fading multipath channels - frequency non selective, slowly fading channels - frequency selective, slowly fading channels- calculation of error probabilities - tapped delay line model - the RAKE demodulator performance - diversity techniques for mobile wireless radio systems concept of diversity branch and signal paths - combining methods - selective diversity combining - pre-detection and post detection combining - switched combining - maximal ratio combining- equal gain combining

Module III (12 hours)
Cellular concept - frequency reuse - cochannel interference - adjacent channel interference - power control for reducing interference - improving capacity in cellular systems - cell splitting - sectoring - hand off strategies - channel assignment strategies - call blocking in cellular networks

Module IV (14 hours)
Fundamental concepts of spread spectrum systems - pseudo noise sequence - performance of direct sequence spread spectrum systems - analysis of direct sequence spread spectrum systems - the processing gain and anti jamming margin - frequency hopped spread spectrum systems - time hopped spread spectrum systems - synchronization of spread spectrum systems

Text books
1. Kamilo Feher, ‘*Wireless Digital Communications*’, PHI
2. Rapport T.S., ‘*Wireless Communications, Principles and Practice*’, Prentice Hall
3. Lee W.C.Y., ‘*Mobile Cellular Telecommunication*’, MGH
EC448T COMMUNICATION SWITCHING SYSTEMS

Module I (12 hours)
Electronic switching systems: basics of a switching system - electronic space division switching - stored program control - time division switching - time multiplexed space switching - time multiplexed time switching - two stage, three stage and N-stage combination switching

Module II (14 hours)
Digital circuit switching networks: two-stage network - three-stage network - n-stage network - non-blocking switches - blocking probability analysis of multistage switches - lee approximation - improved approximate analysis of blocking switch - examples of digital switching systems - AT & T 5ESS and NTI - DMS 100 switching systems

Module III (14 hours)
Elements of traffic engineering: network traffic load and parameters - grade of service and blocking probability - incoming traffic and service time characterization - blocking models and loss estimates - delay systems

Module IV (12 hours)
Signaling: customer line signaling - outband signaling - inband signaling - PCM signaling - inter register signaling - common channel signaling principles - CCITT signaling system No: 7 - digital customer line signaling

Text books

Reference books
1. Flood J.E., Telecommunications Switching Traffic and Networks, Pearson Education Pvt. Ltd.
2. Freeman R.L., Telecommunication System Engineering, Wiley Inter Science Publications

EC449T TELEVISION ENGINEERING & RADAR SYSTEMS

Module I (14 hours)
Principles of television - image continuity - interlaced scanning - blanking - synchronizing - video and sound signal modulation - channel bandwidth - vestigial sideband transmission - VSB correction - positive and negative modulation - transmitter and receiver block diagrams - CCD camera

Module II (14 hours)
Colour TV - Colour perception - luminance, hue and saturation - colour TV camera and picture tube - colour signal transmission - bandwidth - modulation - formation of chrominance signal - principles of NTSC, PAL and SECAM coder and decoder

Module III (14 hours)
Digital TV - composite digital standards - 4 f sec NTSC standard - general specifications - sampling structure - general concept of video bit reduction - MPEG standard - digital transmission - cable TV - cable frequencies - co-axial cable for CATV - cable distribution system - cable decoders - wave traps and scrambling methods
Module IV (10 hours)
Radar systems - radar frequencies - radar equation - radar transmitter and receiver (block diagram approach) - continuous wave radar - frequency modulated CW radar - moving target indicator radar - tracking radar

Text books


Reference books

2. Damacher P., *Digital Broadcasting*, IEE Telecommunications Series


EC457T  SIGNAL COMPRESSION

Module I  Review of Information Theory:
Discrete memoryless information source - Redundancy; Discrete information source with memory – Markov process, The information of a discrete source with memory, Amount of information of _rst order and higher order Markov chains. The discrete memoryless information source - Kraft inequality; Optimal codes; Bounds on the optimal code length; Kraft's inequality for uniquely decodable codes; Source coding theorem; Coding strategies; Shannon-McMillan theorem; Shannon's _rst coding theorem; The discrete information source with memory – Coding aspects; Most probable message; Source coding theorem.

(9 Hours)

Module II  Rate distortion theory: Motivation; The discrete rate distortion function R(D); Properties of R(D); Calculation of R(D); R(D) for the binary source, and the Gaussian source, Source coding theorem(Rate distortion theorem); Converse source coding theorem (Converse of the Rate distortion theorem); Information transmission theorem; The continuous Rate distortion function.

(10 Hours)


(10 Hours)

Module IV (A) Transform coding: Theory and construction of transforms; Karhunen Loeve transform; Discrete Cosine Transform; Wavelet transform; Application to speech and image compression.

(6 Hours)

(IV. B) Subband coding: speech, audio and image coding.

(4 Hours)

Text books:


Reference books: