NATIONAL INSTITUTE OF TECHNOLOGY NAGALAND
CHUMUKEDIMA, DIMAPUR – 797 103

B.Tech Degree Program
Curriculum

Regulations – 2016

Bachelor of Technology in Electronics and Communication Engineering

Semester III

Course Code	Course Title	L	T	P	C
MA201	Engineering Mathematics - III	3	1	0	4
EE202	Electrical Machines	3	0	0	3
EC201	Computer Organization and Architecture	3	0	0	3
EC202	Electromagnetic Fields and Waves	3	0	0	3
EC203	Digital Principles and System Design	3	0	0	3
EC204	Electronic Circuits	3	0	0	3
EC205	Digital Principles and System Design Laboratory	0	0	2	1
EE206	Electrical Machines Laboratory	0	0	3	2
EC206	Electronic Circuits Laboratory	0	0	3	2
TOTAL		**18**	**1**	**8**	**24**

MA201 ENGINEERING MATHEMATICS - III **L T P C**

3 1 0 4

FOURIER SERIES **12**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis

FOURIER TRANSFORM **12**

Fourier integral theorem – Fourier transform pair-Sine and Cosine transforms – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity

PARTIAL DIFFERENTIAL EQUATIONS **12**

Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Singular solutions – Lagrange's Linear equation – Integral surface passing through a given curve – Solution of linear equations of higher order with constant coefficients

APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12**

Method of separation of Variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates

Z – TRANSFORM AND DIFFERENCE EQUATIONS **12**

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and Final value theorems – Formation of difference equation – Solution of difference equation using Z-transform

: 60 Periods

TEXT BOOKS

1. Grewal, B.S. "Higher Engineering Mathematics", 41th Edition, Khanna Publications, New Delhi, 2011.

REFERENCE BOOKS

1. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 2007.

2. Ramana B.V., "Higher Engineering Mathematics", 11th Reprint, Tata McGraw Hill Co. Ltd., New Delhi, 2010.

3. Bali N.P. and Manish Goyal, "A Text Book of Engineering Mathematics", 7th Edition, Lakshmi Publications Private Limited, New Delhi, 2007.

EE202 ELECTRICAL MACHINES

L	T	P	C
3	0	0	3

INTRODUCTION TO ROTATING MACHINES 9

D.C. Machine – Armature Windings – Field Winding – MMF pattern of Commutator and field winding – Singe phase and Three phase A.C. Machines - MMF of distributed windings – Rotating MMF in AC machines – EMF – Time varying and rotational induced EMFs - Losses – Conservation of Energy - Flux Leakages

DC MACHINES 9

Schematic representation of DC Machines – Commutator Action – Effect of Armature MMF – Electromagnetic Torque - Generated Voltage in a DC Machine - Electric Circuit Aspects – Magnetic Circuit Aspects – Testing of Machines – Steady State Performance: Generator and Motor – Commutation and Interpoles – Compensating winding – Methods of starting - Speed and Torque Control of Motors – Braking - Parallel Operation of DC Machines

TRANSFORMERS 9

Principle of operation – EMF Equation – No load Conditions – Effect of Secondary Current – Equivalent Circuit – Phasor Diagrams – Open Circuit and Short Circuit Tests - Load Test - Sumpner's Test – Separation of no load losses – Voltage regulation and efficiency – Parallel operation and load sharing - Auto-Transformer - Time harmonics in transformers – Tap-changing

SYNCHRONOUS MACHINES 9

Salient Pole and Non Salient Pole Generators and Motors - Bondel's Two Reaction Theory - Synchronous Reactance and Impedance - Phasor diagrams – Slip Test – Electrical Load Characteristics - Regulation by EMF, MMF and Potier methods - Parallel operation - V-Curves and inverted V-curves - Synchronous Motor: Starting - Testing – Steady state operating characteristics - Hunting - Synchronous condensers

INDUCTION MACHINES 9

Operating principle - Types of single phase and three phase motors - Methods of Starting Equivalent Circuit and Circle diagram - Methods of Speed Control - Torque-Slip Characteristics - Testing of Motors - Induction generator operation - Line excited and self excited - Cascade connection - Induction frequency converter - High torque cage machines - Induction regulators

Total: 45 Periods

TEXT BOOKS

1. A Fitzgerald, Charles Kingsley, Stephen Umans, "Electric Machinery", 6th Edition, Tata McGraw Hill, 2010.

2. Irving L. Kosow, "Electric Machinery and Transformers", Prentice Hall of India, Second Edition, 2007.

3. C. I. Hubert, " Electric Machines", Pearson Education, 2003.

REFERENCES BOOKS

1. Nagrath I.J. and Kothari D.P., "Electric Machines", Tata McGraw Hill, 2004.

2. Cotton, H., "Electrical Technology", CBS Publishers, New Delhi, 7th edition, 2004.

3. Stephen J.Chapman, "Electric Machinery Fundamentals", McGraw Hill International Edition, 2005.

EC201 COMPUTER ORGANIZATION AND ARCHITECTURE **L T P C**

3 0 0 3

LOGICAL ORGANIZATION OF COMPUTERS 9

Functional Units – Basic Operational Concepts – Bus structures – Data Representation – Instruction Sets – Instruction Set Architecture – Addressing Modes – RISC – CISC – ALU design – Performance and Metrics

DATA REPRESENTATION 9

Signed Number Representation – Fixed and Floating Point Representations – Character representation – Computer Arithmetic – Addition & Subtraction of Signed Numbers – Multiplication – Integer Division – Floating Point Operations

CPU CONTROL UNIT DESIGN 9

Basic Concepts – Multiple Bus Organization – Execution of Complete Instruction – Hardwired Control – Micro Programmed Control – Principles of Pipeline and Vector Processing – Hazards – Data Path and Control considerations – Performance Considerations

MEMORY SYSTEMS 9

Fundamental Concepts – Semiconductor Memory Technologies – Speed – Size and Cost – Cache Memory and Virtual Memory – Performance Consideration – Memory Management Requirements – Secondary Storage

I/O ORGANIZATION 9

Accessing I/O devices – Interrupts – DMA – Buses – Interface Circuits – Standard I/O Interfaces (PCI, SCSI, USB) – I/O devices and processors

Total: 45 Periods

TEXT BOOKS

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization", Fifth Edition, Tata McGraw Hill, 2002.
2. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Third Edition, Elsevier, 2005.

REFERENCE BOOKS

1. William Stallings, “Computer Organization and Architecture: Designing for Performance”, Sixth Edition, Pearson Education, 2003.
2. John P. Hayes, “Computer Architecture and Organization”, Third Edition, Tata McGraw Hill, 1998.
3. V.P. Heuring, H.F. Jordan, “Computer Systems Design and Architecture”, Second Edition, Pearson Education, 2004.
4. Behrooz Parhami, “Computer Architecture”, Oxford University Press, 2007.

EC202 ELECTROMAGNETIC FIELDS AND WAVES

L	T	P	C
3	0	0	3

REVIEW OF MATHEMATICAL CONCEPTS AND ELECTROSTATICS 9

Vector fields - Different co-ordinate systems, Vector calculus, Gradient, Divergence and Curl, Divergence theorem, Stoke's theorem – Fundamental concepts and laws of Electrostatics – Electric Field and Potential values due to various types of sources – Solutions in rectangular, cylindrical and spherical coordinates

ELECTROSTATIC FIELD IN VARIOUS MEDIA 9

Study of various types of medium – Electric field in dielectrics and free space – Boundary value problems– Applications of Electrostatic fields

STATIC MAGNETIC FIELDS 9

Fundamental concepts and laws of static magnetic fields – Magnetic Field and potential values due to various types of sources – Solutions in rectangular, spherical and cylindrical coordinates - Boundary value problems in magnetostatics

TIME VARYING ELECTRIC AND MAGNETIC FIELDS 9

Fundamental concepts and laws of time varying electric and magnetic fields – Maxwell's equations - Poynting vector - Relation between field theory and circuit theory

ELECTROMAGNETIC WAVES 9

Transverse electromagnetic waves - Sinusoidal time variations - Wave equations in free space, lossy and lossless dielectrics, conductors – Wave equation in Phasor form - Wave parameters – Uniform and Non uniform plane waves — Skin effect – Reflection of Plane Wave from a perfect conductor – Normal and Oblique incidence onto a perfect conductor – Reflection of Plane Waves by a perfect dielectric – Normal and oblique incidence on to a perfect dielectric - Linear, Elliptical and circular polarization - Dependence on Polarization - Brewster angle

Total: 45 Periods

TEXT BOOKS

1. Zahn, Markus, "Electromagnetic Field Theory: A Problem Solving Approach" Malabar, FL: Krieger Publishing Company, 2003.

2. E.C. Jordan & K.G. Balmain “Electromagnetic Waves and Radiating Systems", Fourth Edition, Pearson Education / PHI, 2006.

REFERENCE BOOKS

1. J.A.Edminister, Schaum’s Outlines “Theory and problems of Electromagnetics”, Second Edition, Tata McGraw-Hill, Special IndianEdition 2006.
2. Mattew N. O. Sadiku “Elements of Electromagnetics”, 5th Edition, Oxford University Press, 2010.
3. William H.Hayt Jr. and John A Buck “Engineering Electromagnetics”, Seventh Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2006.
4. D.K. Cheng, “Field and Wave Electromagnetics”, Pearson Education, 2003.

EC203 DIGITAL PRINCIPLES AND SYSTEM DESIGN

L	T	P	C
3	0	0	3

INTRODUCTION **9**

Electronic components, logic symbols and gates - Number Systems, Conversions and Codes - Boolean algebra and Switching Function - Boolean minimization using algebraic, Karnaugh map and Quine – McClausky methods - Realization using logic gates

COMBINATIONAL LOGIC DESIGN USING MSI CIRCUITS **9**

Design BCD Adder - Full Adder: Ripple Carry Adder, Look Ahead Carry Adder - Subtractor – Multipliers - Encoder, Decoder, - Multiplexer, Demultiplexer - Tri-state buffers, Combinational logic design using ROM, EEPROM array

SEQUENTIAL LOGIC DESIGN USING MSI CIRCUITS **9**

Flip-flops, excitation tables - Practical clocking aspects - Timing and triggering considerations - Analysis of Asynchronous and Synchronous sequential circuits: State tables, State Minimization and Assignment, Moore and Mealy model – Race free assignment

Circuit analysis and design with Verilog / VHDL: Registers - shift registers, Ripple counters, Synchronous counters, Timing signal, RAM, Memory decoding, Semiconductor memories - Feedback sequential- Synthesis of completely and incompletely specified synchronous sequential M/Cs

DIGITAL LOGIC FAMILIES **9**

Logic Families - CMOS Logic - Electrical Behavior of CMOS Circuits - CMOS Steady-State Electrical Behavior - CMOS Dynamic Electrical Behavior - CMOS Logic Families - Bipolar Logic - Transistor-Transistor Logic - TTL Families. CMOS/TTL Interfacing. Low-Voltage CMOS Logic and Interfacing - Emitter-Coupled Logic

DESIGN OF DIGITAL SYSTEMS **9**

PLD - Architecture & Characteristics - State diagrams and their features - Design flow: functional partitioning, timing relationships, state assignment, output racing - Top down approach to digital system design - Design examples using PLDs

Total: 45 Periods

TEXT BOOKS

1. John F. Wakerly, "Digital Design Principles and Practices", Fourth Edition, Prentice Hall India, 2005
2. M. Morris Mano, Michael D. Ciletti, “Digital Design: With an Introduction to the Verilog HDL”, Fifth Edition, Pearson, 2013

REFERENCE BOOKS

1. Donald D. Givone, "Digital Principles and Design", McGraw-Hill, 2003
2. Charles H. Roth, Jr., Larry L. Kinney, "Fundamentals of Logic design", Seventh Edition, Cengage Learning, 2010
3. Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, "Digital Systems: Principles and Applications", Tenth Edition, Pearson Prentice Hall, 2007

EC204 ELECTRONIC CIRCUITS **L T P C**

3 0 0 3

BJT AMPLIFIERS 9

Biasing Methods - Stability - Bias compensation - Thermal stability - Small signal Analysis of Common Emitter, Common collector and common base amplifiers – Voltage swing limitations - Cascaded stages - Cascode Amplifier - Differential amplifiers – CMRR - Darlington Amplifier - Bootstrap technique – Current Sources – Design of amplifiers

JFET AND MOSFET AMPLIFIERS 9

Biasing Methods - Stability - Bias compensation - Thermal stability - Small signal Analysis of Source-Follower Common-Drain, Common-Gate amplifiers- Cascade, Cascode Amplifiers – Differential Amplifiers - CMOS Inverters –DC Analysis of CMOS Inverters – Voltage transfer curve – Design of NMOS inverter using resistive load – Noise Margin - Design of amplifiers

HIGH FREQUENCY ANALYSIS & LARGE SIGNAL AMPLIFIERS 9

Short circuit current gain, cut off frequency – f_α and f_β unity gain and bandwidth - Miller effect – Frequency Analysis of CS and CE Amplifiers - Determinations of BW of Single stage and Multistage Amplifier - Analysis of Class A, Class B, Class AB with Darlington output stage and with output stage utilizing MOSFETs – Class C, Class D, Class E power amplifiers

FEEDBACK AMPLIFIERS 9

Basic feedback concepts – Properties of negative feedback – Four feedback topologies with amplifier circuit - Examples – Analysis of series, shunt feedback Amplifiers – Stability problem – Frequency compensation

OSCILLATORS 9

Barkhausen criteria – RC oscillators: Phase Shift, Wein Bridge oscillators – LC oscillators: Colpitt, Hartley, Clapp, Crystal, Armstrong, Franklin and Ring Oscillators – Voltage Controlled Oscillators – Phase Locked Loop

Total: 45 Periods

TEXT BOOKS

1. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.

2. J. Millman and Halkins, Satyebranta Jit, "Electronic Devices and Circuits", 2nd Edition, Tata McGraw-Hill Publishing, 2008.

REFERENCE BOOKS

1. Robert L. Boylestad, Louis Nashelsky, “Electronic Devices And Circuits Theory”, 9th Edition, Pearson, 2009.

2. Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, Tata McGraw Hill, 2007.

3. Robert T. Paynter, "Introducing Electronics Devices and Circuits", 7th Edition, Pearson Education, 2006.

4. Adel S. Sedra, Kenneth C. Smith, “Micro Electronic circuits”, 6th Edition, Oxford University Press, 2010.

EC205 DIGITAL PRINCIPLES AND SYSTEM DESIGN LABORATORY

L	T	P	C
0	0	2	1

1. Study of Basic Digital IC's:

- Verification of Truth Table for AND, OR, XOR, NOT, NOR and NAND

2. Study of Flip-Flops: (using both Trainer Kit and VHDL)

- Functional Analysis of JK Flip-Flop, RS Flip-Flop, D Flip-Flop, T Flip-Flop and Gated SR Latch

3. Implementation of Boolean Functions: (using both Trainer Kit and VHDL)

- Adder/ Subtractor circuits

4. Code converters:

- Encoders and Decoders
- Parity generator and parity checking, Excess - 3, 2's Complement, Binary to Gray code using suitable IC's.

5. Shift Registers:

- Design and implementation of 4- bit shift registers in SISO, SIPO, PISO, PIPO modes using suitable IC's.

6. Multiplex/ De-multiplex: (using both Trainer Kit and VHDL)

- Study of 4:1; 8:1 multiplexer and Study of 1:4; 1:8 de-multiplexer.

7. Counters: (using both Trainer Kit and VHDL)

- Design and implementation of 4 - bit modulo counters as Synchronous and Asynchronous types using Flip-Flop IC's and specific counter IC
- Binary counter
- Decade counter with decoder/driver and seven segments LED display
- Ring counter

8. Design of sequential logic circuits
9. Design of combinational logic circuits
10. Electronic gain using bi-directional shift registers

EE206 ELECTRICAL MACHINES LABORATORY

L	T	P	C
0	0	3	2

1. Load characteristics of DC shunt motor
2. Swinburne’s test, Hopkinson's Test and Sumpner's Test
3. Speed control of DC shunt motor
4. Open circuit and load characteristics of separately excited DC generator
5. Open circuit and load characteristics of DC shunt generator
6. Load test on single-phase transformer
7. Open circuit and short circuit tests on single phase transformer
8. Separation of no load losses in a single phase transformer
9. Load test on three phase alternator
10. V and inverted V curves of three phase synchronous motor
11. Load characteristics of three phase induction motor
12. No load and blocked rotor test on three phase induction motor
13. Load test on single phase induction motor
14. Slip Test and Determination of X_d and X_q
15. Speed Control of three phase induction motor
16. Regulation of three phase alternator by E.M.F. and M.M.F. methods

EC206 ELECTRONIC CIRCUITS LABORATORY

L	T	P	C
0	0	3	2

1. Design and construct of feedback Amplifiers
2. Design and construct of RC Oscillator
3. Design and construct of LC Oscillator
4. Design and construct of single and multiple Tuned Amplifiers
5. Design and construct of Astable Multivibrator
6. Design and construct of Monostable Multivibrator
7. Cadence Tutorial
8. Design, simulate, layout, and test cascode current-mirror circuits.
9. Design, simulate, layout, and test cascade current-mirror circuits.
10. Design, simulate, and layout various inverting amplifier with current-mirror as the active load.
11. Design, simulate, and layout various inverting amplifier with diode connected transistors as load.
12. Design, simulate, and layout various differential pairs used in different types of differential amplifiers
13. PSpice simulation of experiments from 1 to 6

Department of Electronics and Communication Engineering

Semester IV

Course Code	Course Title	L	T	P	C
MA252	Probability and Random Processes	3	1	0	4
SH251	Engineering Economics	3	0	0	3
EC251	Control Systems Engineering	3	0	0	3
EC252	Communication Theory	3	1	0	4
EC253	Linear Integrated Circuits	3	0	0	3
EC254	Microprocessors and Microcontrollers	3	0	0	3
EC255	Control Systems Laboratory	0	0	3	2
EC256	Linear Integrated Circuits Laboratory	0	0	2	1
EC257	Microprocessors and Microcontrollers Laboratory	0	0	3	2
TOTAL		**18**	**2**	**8**	**25**

MA252 PROBABILITY AND RANDOM PROCESSES **L T P C**
3 1 0 4

Probability Theory **12**

Basic Concepts of Set Theory – Probability Concepts – Probability using Counting Method – Conditional Probability – Repeated Trials

Random Variables **12**

Discrete and Continuous random variables - Moments - Moment generating Functions – Conditional Distributions and Density Functions - Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions – Expected Value of a Random Variable - Functions of a random variable

Two-Dimensional Random Variables **12**

Joint distributions - Marginal and Conditional distributions - Covariance - Correlation and Linear regression – Transformation of random variables - Convergence - Central limit theorem (for independent and identically distributed random variables) – Random Vector – Vector Space Interpretation of Random Variables.

Random Processes **12**

Classification - Stationary process - Real WSS Random Process - Poisson process - Continuity and Differentiation of Random Processes - Time Averages and Ergodicity - Linear Time-Invariant System – Discrete-Time Linear Shift Invariant System – Cross Power Spectral Density.

Applications **12**

Optical Communication Link – Digital Wireless Communication Link – M/M/1 Queue – Simple Game – Decision Making – Detection and Hypothesis Testing: Bayesian – Maximum Likelihood Estimation – Hypothesis Testing Problem.

Total: 60 Periods

Text books

1. Oliver Ibe, “Fundamentals of Applied Probability and Random Processes”, Academic Press, 2005.

2. Venkatarama Krishnan, “Probability and Random Processes”, John Wiley & Sons, 2006.

Reference Books

- Scott L.Miller and Donald G.Childers, “Probability and Random Processes: With Applications to Signal Processing and Communications”, Academic Press, 2004.
- Arnold O.Allen, “Probability, Statistics and Queueing Theory with Computer Science Applications”, 2nd Edition, Academic Press, 1990.
- Hwei Hsu, “Schaum’s Outline of Probability, Random Variables and Random Processes”, 2nd Edition, McGraw-Hill Education, 2010.

SH251 ENGINEERING ECONOMICS **L T P C**
3 0 0 3

BASIC ECONOMICS **9**

Economics - Definition – Nature and Scope of Economic Science – Managerial Economics – Basic terms and concepts: goods – utility – value – wealth – factors of production – labour – large scale economics – small scale economics – Law of diminishing marginal utility - Firms: Types, objectives and goals - Managerial decisions - Decision analysis – relation between economic decision and technical decision

DEMAND AND SUPPLY ANALYSIS **9**

Demand - Types of demand - Law of demand - demand function - demand forecasting - demand schedule - demand curve - law of demand - elasticity of demand - Types of elasticity - factors determining elasticity - Supply - Supply schedule - Supply curve - Law of supply - Elasticity of supply - time element in the determination of value - market price and normal price - perfect competition - monopoly - monopolistic competition

PRODUCTION AND COST ANALYSIS **9**

Production function - Returns to scale - Production optimization - Least cost input - Managerial uses of production function - Cost Concepts - Cost function - Determinants of cost - Estimation of Cost – traditional costing approach – activity base costing - fixed cost – variable cost – marginal cost - Short run and Long run cost curves - Cost Output Decision.

PRICING **9**

Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice – full cost pricing – marginal cost pricing – going rate pricing – bid pricing – cost benefit analysis – break even analysis – basic assumptions – break even chart – managerial uses of break even analysis

FINANCIAL ACCOUNTING AND CAPITAL BUDGETING **9**

Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative financial statements - Analysis and Interpretation of financial statements - Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return.

Total: 45 Periods

TEXT BOOKS

1. Samuelson. Paul A and Nordhaus W.D., "Economics", Tata Mcgraw Hill Publishing Company Limited, New Delhi, 2004.

2. McGuigan, Moyer and Harris, "Managerial Economics; Applications, Strategy and Tactics", Thomson South Western, 10th Edition, 2005, New Delhi, 2007.

3. Prasanna Chandra. "Fundamentals of Financial Management", Tata Mcgraw Hill Publishing Ltd., 4th edition, 2005.

REFERENCE BOOKS

1. Dewett K.K. & Varma J.D., Elementary Economic Theory, S Chand & Co., 2006

2. Barthwal R.R., Industrial Economics - An Introductory Text Book, New Age

3. Khan MY and Jain PK “Financial Management” McGraw-Hill Publishing Co., Ltd.

4. Paresh Shah, 'Basic Financial Accounting for Management', Oxford University Press.

EC251 CONTROL SYSTEMS ENGINEERING **L T P C**
3 0 0 3

MATHEMATICAL MODELS AND ANALYSIS **9**

Classification of Systems – Analogous Systems - Mathematical representation of various systems - Linear Time Invariant system - Time-varying system - Relationship between Transfer Function and Impulse Response - Order of a System - Block diagram - Signal Flow Graphs - Derivation of transfer functions of Electrical and Electromechanical Systems.

PHYSICAL SYSTEMS AND APPLICATIONS **9**

Open and Closed loop systems – Controller servomechanism: Basic elements -Types – Causal system – Physical System representation by Differential Equations - Control System Components: Potentiometer, A.C. Servo motors - D.C. and A.C. Tachogenerators - Example of closed loop systems using D.C. & A.C. Servomotors - Synchros – Feedback - Effects of feedback on sensitivity – Stability - External disturbance and other factors.

TIME DOMAIN ANALYSIS **9**

Typical test signals – Performance characteristics of feedback control systems – Transient and Steady state time response of First and second order systems - Positional servomechanism – PI, PD, PID controllers – Effects of controllers on the responses –Steady State Error - Error constants – Dominant closed loop poles – Pole zero configuration – Stability - Routh Hurwitz stability criterion – Relative Stability – Root locus for various systems.

FREQUENCY DOMAIN ANALYSIS **9**

Frequency domain specifications of feedback control systems - Polar plots - Bode plots - – Determination of Transfer Function from Bode Plot - Nyquist criterion and stability – Application of the Nyquist criterion - Effects of additional poles and zeros - Relative stability.

COMPENSATOR DESIGN **9**

Lag, Lead, Lag-Lead, Lead-Lag Compensators - Design using Root Locus and Bode Plot Methods - State variable analysis: State variable and State model - State models for linear and continuous time systems - Derivation of State model from transfer functions - Solution of State equations – Controllability and Observability.

Total : 45 Periods

TEXT BOOKS

1. K.Ogata, "Modern Control Engineering", 5th Edition, Prentice Hall India, 2010.

2. I.J.Nagrath and M.Gopal, "Control Systems Engineering", 4th Edition, New Age International, New Delhi, 2005.

REFERENCE BOOKS

3. Benzamin C.Kuo, "Automatic Control Systems", 7th Edition, Prentice Hall India, New Delhi, 2003.

4. Madan Gopal, "Control Systems: Principles and Design", 2nd Edition, Tata McGraw Hill, 2002.

EC252 COMMUNICATION THEORY **L T P C**
3 1 0 4

Fundamentals **12**

Basic Blocks of Communication System – Elements - Communication Process –

Sources of Information – Communication Channels – Signals and their Classifications - Baseband and Passband Signals – Probabilistic considerations – Random Variables - Random Processes – Gaussian Process – Modulation Process and Techniques – Communication Resources – Analog versus Digital Communications – Time-Frequency Analysis

Amplitude Modulation **12**

Linear Modulation – AM, DSB-SC, SSB and VSB Signals – Methods of Generation and Detection – Time-Domain and Frequency-Domain Description of signals - Filtering of Sidebands - Comparison of Amplitude Modulation techniques - Frequency Translation - Frequency Division Multiplexing – AM Transmitter and Receiver – Radio Broadcasting - Superheterodyne Receiver.

Angle Modulation **12**

Basic Definitions – FM: Narrow Band FM - Wide Band FM - Transmission Bandwidth of FM Waves - Generation of FM waves: Indirect FM and Direct FM - Demodulation of FM waves - FM stereo multiplexing - Phase-Locked Loop - Nonlinear model of the Phase-Locked Loop - Linear model of the Phase-Locked Loop - Nonlinear effects in FM systems – FM Broadcast Receivers

Noise Theory **12**

Fundamentals - Shot Noise - Thermal Noise - White Noise - Noise Equivalent Bandwidth - Narrow Bandwidth - Noise Figure - Equivalent Noise Temperature - Noise in Continuous Wave Modulation Systems: Noise in DSB-SC receivers - Noise in SSB receivers - Noise in AM receivers – SNR Calculations - Threshold effect - Noise in FM receivers - FM threshold effect - Pre-emphasis and De-emphasis in FM.

Information Theory **12**

Discrete Messages – Information and Entropy – Source Coding Theorem – Channel Capacity – Channel Coding Theorem – Differential Entropy – Mutual Information for Continuous Ensembles – Information Capacity Theorem and its Implication – Rate Distortion Theory – Compression of Information.

Total: 60 Periods

Text Books

1. Simon Haykin, "Communication Systems**",** 3rd Edition, John Wiley & Sons, 2008.
2. Simon Haykin, "An Introduction to Analog and Digital Communications", John Wiley & Sons, 2009.

Reference Books

1. B. P. Lathi and Zhi Ding, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2010.
2. A.Bruce Carlson, Paul Crilly and Paul B. Crilly, "Communication Systems", 5th Edition, McGraw-Hill Higher Education, 2009.
3. Herbert Taub, Donald L.Schilling and Goutam Saha, "Principles of Communication Systems", 3rd Edition, Tata McGraw-Hill, 2008.

EC253 LINEAR INTEGRATED CIRCUITS **L T P C**
3 0 0 3

Introduction to Operational Amplifiers

ICs Classification – Fundamentals of Monolithic IC Technology – Masking and Etching – Diffusion of Impurities - Advantages of ICs over discrete components - Internal Circuit diagram of an IC - Characteristics of Operational Amplifiers: Ideal characteristics – DC Characteristics – AC Characteristics – Frequency Response of Operational Amplifiers

Applications of Operational Amplifiers

Phase Shifter - Summing, Scaling and Averaging amplifiers – Subtractor - Instrumentation Amplifier -Voltage-to-Current Converter - Current-to-Voltage

Converter – Integrator – Differentiator – Log and Antilog Amplifier - Peak Detector - Precision Rectifiers –Comparator - Zero Crossing Detector - Schmitt Trigger - Clippers and Clampers

Analog to Digital and Digital to Analog Converters

Analog and Digital Data Conversion - sample-and-hold circuits - D/A converter – Specifications - Weighted Resistor type - R-2R Ladder type: Voltage Mode and Current Mode R2R Ladder types - switches for D/A converters - A/D Converter specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type

Active Filters and Oscillators

Active Filters - Butterworth Low and High Pass Filters - Band-Pass Filters - Band Reject Filters - Oscillators and Wave Generators: Phase Shift Oscillator - Wien Bridge Oscillator – Multivibrator - Square Wave Generator - Voltage-Controlled Oscillator - Triangular Wave Generator - Saw-tooth Wave Generator

Specialized IC Applications

555 Timer Circuit - Monostable and Astable Multivibrator using IC 555 - Phase Locked Loop Circuit functioning and applications - Voltage Regulators - Three terminal fixed and adjustable voltage regulators - General purpose regulators - Monolithic switching regulators

Total: 45 Periods

Text Books

1. Ramakant A. Gayakwad, “Op-Amps and Linear Integrated Circuits”, 4th Edition, Prentice Hall, 2000.

2. Roy Choudhury, D. and Shail B.Jain, “Linear Integrated Circuits”, 2nd Edition, New Age International (p) Limited, 2003.

Reference Books

1. Herbert Taub and Donald Schilling, “Digital Integrated Electronics”, Tata McGraw-Hill, 2008

2. Paul R.Gray, Paul J.Hurst, Stephen H.Lewis and Robert G.Meyer, "Analysis and Design of Analog Integrated Circuits", 4th Edition, John Wiley & Sons, 2001.

3. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd Edition, Tata McGraw-Hill Edition, 2002.

4. Jacob Millman and Christos C.Halkias, "Integrated Electronics - Analog and Digital Circuits Systems", Tata Mc-Graw Hill Edition, 1991.

5. Robert F. Coughlin and Frederick F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits", 6th Edition, Prentice Hall, 2001.

6. David A. Bell, "Operational Amplifiers and Linear ICs", 2nd Edition, Oxford University Press, 2007.

EC254 MICROPROCESSORS AND MICROCONTROLLERS **L T P C**
3 0 0 3

MICROPROCESSORS **9**

Intel 8085 Microprocessor – Architecture - Instruction set and Programming - Introduction to 16 Bit Microprocessor - Architecture of 8086 CPU architecture - Internal operations – Instruction set and Programming - Comparison of 8085, 8086 and 8088.

INTERFACING PERIPHERALS WITH MICROPROCESSORS 9

Programmable peripheral interface (8255A) – USART (8251A) - Keyboard and display controller (8279) - Programmable Interrupt controller (8259) - DMA controller (8257) -Programmable Timer Controller (8254) - Digital to Analog and Analog to Digital Converters

INTEL 8051 MICROCONTROLLER 9

Intel 8051 architecture – Programming techniques using C and Assembly Instruction set – Timer and counter programming – Serial Port Programming - Interrupt Programming – I/O Port programming - Interfacing with LCD & Keyboard - ADC, DAC - Sensor, External Memory - RTC Interfacing using I^2C Standard - LED, LCD and 7 segment display

PIC MICROCONTROLLER 9

Architecture – Instruction set – Programming techniques using C and Assembly languages - Timers – Capture / Compare / PWM (CCP) Modules - Interrupts – I/O ports – I^2C bus for peripheral chip access – A/D converter – USART

APPLICATIONS USING 8051 AND PIC MICROCONTROLLERS 9

Temperature sensor interfacing - PWM signal generation – PID control of DC motor – Stepper Motor Driver Circuit - Communication between two systems using RF modules

Total: 45 Periods

TEXT BOOKS

1. Ramesh S. Gaonkar, "Microprocessor Architecture Programming and Applications with 8085", Fourth edition, Prentice Hall, 2002

2. B. B. Bray, The Intel Microprocessors- 8086/8088, 80186, 80286, 80386, and 80486-Architecture, Programming and Interfacing, Prentice Hall, 2000
3. Kenneth Ayala, "The 8051 Microcontroller", Third edition, Cengage Learning, 2005

4. John Iovine, 'PIC Microcontroller Project Book ', McGraw-Hill 2000.

5. Mazidi, Rolin McKinlay, Danny Causey, "PIC Microcontroller and Embedded Systems: using Assembly and C for PIC 18", Prentice Hall, 2009

REFERENCE BOOKS

11. Walter A-Tribel & Avtar Singh "The 8088 and 8086 Microprocessors programming -Interfacing -software -Hardware and Application", Fourth Edition, Pearson / PHI, 2003

12. Douglas V-Hall "Microprocessor and interfacing", Second Edition, Tata Mc Graw Hill, 2002

13. Ramesh Gaonkar, "Fundamentals of Microcontrollers and Applications in Embedded Systems with PIC", Delmar Cengage Learning, 2007

14. Muhammad Ali Mazidi-Jamice Gillispit Mazidi-"The 8051 micro controller and Embedded System" Pearson Education, 2002

15. Julio Sanchez Maria P.Canton, "Microcontroller Programming, The Microchip PIC", CRC Press, Taylor & Francis Group, 2007

EC255 CONTROL SYSTEMS LABORATORY **L T P C**
0 0 3 2

17. Determination of transfer function of a DC Servomotor.

18. Determination of transfer function of a AC Servomotor.
19. Analog simulation of Type-0 and Type-1 systems.
20. Determination of transfer function of a DC Generator.
21. Determination of transfer function of a DC Motor.
22. Stability analysis of linear systems using conventional techniques
23. Stepper motor control system.
24. Digital simulation of Linear and Non-linear systems (first-order and second-order systems)
25. Study of P, PI and PID controllers and its applications to SISO systems.
26. Study of Lag, Lead, Lead-Lag compensators and its application to SISO systems.
27. Open and Closed loop control system design.

EC256 LINEAR INTEGRATED CIRCUITS LABORATORY **L T P C**
0 0 2 1

1. Study of Linear Op-Amp circuits:

1. Voltage follower
2. Inverting Amplifier (Closed Loop Configuration)
3. Non-inverting Amplifier (Closed Loop Configuration)

2. Op-Amp Linear Applications:
    1. Differentiator
    2. Integrator
    3. Subtractor
    4. Comparator circuits

1. Zero Crossing Detector
2. Window Detector
3. Schmitt Trigger

3. Sample and Hold Circuits

4. Astable and Monostable Multivibrator using Op-Amp

5. Astable and Monostable Multivibrator using IC 555

6. DAC Converters using Op-Amp

7. Frequency response of 2nd order Low Pass Filter and High Pass Filter

8. Frequency response of 2nd order Band Stop Filter and Band Pass Filter

9. Application of Multiplier (voltage squarer, voltage divider, square rooter)

10. Oscillators using Operational Amplifier

4. Wein Bridge Oscillators
5. RC Phase Shift Oscillators

11. Voltage regulation using IC LM723 (low voltage regulator and High Voltage regulators)

12. Op-Amp Non Linear Application:
    - Clipper, Clamper, Peak detector and Timer IC application

13. Study of VCO and PLL ICs:

1. Voltage to frequency characteristics of NE / SE 566 IC.
2. Frequency multiplication using NE / SE 565 PLL IC.

14. PSpice simulation of experiments 4, 5, 7 and 10.

EC257 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

L	T	P	C
0	0	3	2

1. Programs for 8/16 Bit Arithmetic Operations: Multi precision addition / subtraction / multiplication / division.

2. Programming with control instructions: Increment / Decrement, Ascending order / Descending order, Maximum / Minimum of numbers, Rotate instructions, Hex / ASCII / BCD code conversions

3. Programs for Sorting and Searching

4. Programs for Digital Clock and Stop Watch

5. Interfacing ADC and DAC

6. Interfacing of 7 segment LED display

7. Traffic Light Controller

8. Interfacing of Relay Circuit

9. Parallel Communication between Two Microprocessor Kits using Mode 1 and Mode 2 of 8255

10. Serial Communication between Two Microprocessor Kits using 8251

11. Demonstration of basic instructions with 8051 / PIC18FXX2 Microcontroller execution, including: Conditional jumps, looping, Calling subroutines and Stack parameter testing

12. Programming using Arithmetic, Logical and Bit Manipulation Instructions of 8051/ PIC18FXX2 Microcontrollers

13. Stepper Motor and DC Motor Speed control using 8085 / 8051

14. Programming and Verifying Timer, Interrupts and UART Operations in PIC18FXX2

15. Communication between 8051 / PIC18FXX2 Microcontroller Kits and PC

Semester V

Course Code	Course Title	L	T	P	C
EC301	Digital Communication Techniques	3	0	0	3
EC302	Measurements and Instrumentation	3	0	0	3
EC303	Data Communication and Networks	3	0	0	3
EC304	Signals and Systems	3	0	0	3
EC904	Advanced Network Analysis	3	0	0	3
EC907	Antenna and Wave Propagation	3	0	0	3
EC305	Measurements and Instrumentation Laboratory	0	0	3	2
EC306	Digital Communication Laboratory	0	0	3	2
EC307	Networks Laboratory	0	0	3	2
TOTAL		**18**	**0**	**9**	**24**

EC301 DIGITAL COMMUNICATION TECHNIQUES **L T P C**
3 1 0 4

FUNDAMENTALS OF ANALOG COMMUNICATION 12

Principles of Amplitude Modulation – AM Envelope – Frequency Spectrum and Bandwidth – Modulation Index and Percent Modulation – AM Voltage Distribution – AM Power Distribution – Angle Modulation – FM and PM Waveforms – Phase Deviation and Modulation Index – Frequency Deviation and Percent Modulation – Frequency Analysis of Angle Modulated Waves – Bandwidth Requirements for Angle Modulated Waves

DIGITAL COMMUNICATION 12

Shannon Limit for Information Capacity – Digital Amplitude Modulation – Frequency Shift Keying – FSK Bit Rate and Baud – FSK Transmitter – BW Consideration Of FSK – FSK Receiver – Phase Shift Keying – Binary Phase Shift Keying – QPSK – Quadrature Amplitude Modulation – Bandwidth Efficiency – Carrier Recovery – Squaring Loop – Costas Loop – DPSK - Linear block codes, encoding and decoding - Cyclic codes - Convolutional codes - Viterbi decoding

DIGITAL TRANSMISSION 12

Pulse Modulation – PCM – PCM Sampling – Sampling Rate – Signal to Quantization Noise Rate – Companding – Analog and Digital – Percentage Error – Delta Modulation – Adaptive Delta Modulation – Differential Pulse Code Modulation – Pulse Transmission – Inter symbol Interference – Eye Patterns

DATA COMMUNICATIONS 12

History of Data Communications – Standards Organizations for Data Communication – Data Communication Circuits – Data Communication Codes – Error Control – Error Detection – Error Correction – Data Communication Hardware – Serial and Parallel Interfaces – Data Modem – Asynchronous Modem – Synchronous Modem – Low-Speed Modem – Medium and High Speed Modem – Modem Control

SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES 12

Introduction – Pseudo - Noise Sequence – Direct Spread Spectrum with Coherent Binary PSK – Processing Gain – Frequency Hop Spread Spectrum – Jamming Margin - Multiple Access Techniques – Wireless Communication – TDMA and CDMA In Wireless Communication Systems – Source Coding of Speech for Wireless Communications

Total: 60 Periods

TEXT BOOKS

3. Wayne Tomasi, "Advanced Electronic Communication Systems", Sixth Edition, Pearson Education, 2007.

4. Simon Haykin, "Communication Systems", Fourth Edition, John Wiley and Sons, 2001.

REFERENCE BOOKS

1. H. Taub, D L Schilling and G Saha, "Principles of Communication", Third Edition, 2007.

2. B.P. Lathi, "Modern Analog and Digital Communication Systems", Third Edition, Oxford University Press, 2007.

3. Blake, "Electronic Communication Systems", Thomson Delmar Publications, 2002.

4. Martin S. Roden, "Analog and Digital Communication System", Third Edition, Prentice Hall of India, 2002.

5. B. Sklar, "Digital Communication Fundamentals and Applications", Second Edition, Pearson Education, 2007.

EC302 MEASUREMENTS AND INSTRUMENTATION

L	T	P	C
3	0	0	3

Basics **9**

Functional Elements of an Instrument - Static and Dynamic characteristics – Errors – Statistical evaluation of measurement data – Standards and calibration - Transducers: Classification - Selection of transducers – Resistive, capacitive & inductive – Piezoelectric - Optical and Digital transducers – OPAMP applications in measurement and transducer Circuits.

Measurement of Electrical and Magnetic Parameters **9**

Principles and Types of Analog and Digital Instruments – voltmeter – Ammeter – Multimeter – Single and Three phase Watt Meter and Energy Meter – DC and AC Voltage measurement – Guarding Techniques - Frequency, period, time interval and pulse width measurements – Magnetic measurements – Instrument transformer – Instruments for measuring Frequency and Phase – Measurement of Resistance, Inductance, Capacitance and Frequency using Bridges.

Measurement of Physical and Mechanical Parameters **9**

Measurement of Pressure, Temperature: Thermocouple – Pyrometer – Flow: Flow meters – Rotameter – Electromagnetic Flow Meter – Level: Mechanical, Electrical and Optical Level Indicators – Speed: Tachometer – Gyroscope – Acceleration – Humidity: Wet and Dry Bulb Hygrometer.

Data Acquisition Systems **9**

Elements of Data Acquisition System – Signal conditioning – PC based Data Acquisition Systems – Interfacing and bus standards – Programmable Logic Controllers and their industrial applications.

Signal Generators, Oscilloscope and Waveform Analyzers **9**

CRO – Analog and Digital Storage Oscilloscope – Digital Phosphor Oscilloscopes – A.F. Generator – Pulse Generator - AM / FM Signal Generator – Function Generator – Sweep Frequency Generator - Wave Analyzer – Spectrum Analyzer – Logic Analyzers.

Total: 45 Periods

Text Books

3. A.K.Sawhney and Puneet Sawhney, "A Course in Electrical and Electronics Measurements and Instrumentation", 18th Edition, Dhanpat Rai & Company, 2010.

4. William David Cooper, "Electronic Instrumentation And Measurement Techniques", 2nd Edition, Prentice Hall, 1998.

Reference Books

3. Mike Tooley, "PC Based Instrumentation and Control", 3rd Edition, Elsevier Butterworth-Heinemann Publications, 2005

4. Ernest O. Doebelin and Danesh N.Manik, "Measurement Systems", 6th Edition, Tata McGraw-Hill Edition, 2011.

5. Ernest O. Doebelin, "Measurement Systems – Application and Design", 2nd Edition, McGraw-Hill Edition, 1975.

6. C.S.Rangan, G.R.Sarma and V.S.V.Mani, "Instrumentation - Devices and Systems", Tata Mc-Graw Hill, 1997

7. M.M.S. Anand, "Electronic Instruments and Instrumentation Technology", Prentice Hall of India, 2006

EC303 DATA COMMUNICATION AND NETWORKS **L T P C**
3 0 0 3

Communication Fundamentals **9**

Data Transmission Concepts and Terminology – Synchronous and Asynchronous Transmission – Modulation - Transmission Media - Digital Encoding Techniques - Digital Data Communication Techniques - Data Communication Protocols.

Network Fundamentals **9**

Protocol Architecture – OSI – TCP/IP – LAN architecture – Topologies – MAC – Ethernet - Fast Ethernet - Token Ring – FDDI - Wireless LANS: 802.11 / Wi-Fi / Bluetooth / WiMAX.

Network Layer **9**

Network Layer functions – Switching concepts – Circuit Switching networks – Packet Switching – Routing – Internetworking concepts – IP – Unreliable connectionless delivery – Datagrams – Routing IP datagrams – ICMP.

Transport Layer **9**

Transport Layer functions – User Datagram Protocol – Transmission Control Protocol – Reliable Delivery Service – Connection Establishment – Flow Control – Congestion Control – Queuing disciplines – Congestion Avoidance.

Applications **9**

Domain Name System – Telnet – rlogin – FTP – SMTP – MIME – IMAP – HTTP – SNMP – Security.

Total: 45 Periods

Text Books

1. Larry L. Peterson and Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers, 2012.

Reference Books

1. William Stallings, "Data and Computer Communications", Ninth Edition, Prentice Hall India, 2004.

2. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", Sixth Edition, Addison-Wesley, 2008.

EC304 SIGNALS AND SYSTEMS **L T P C**
3 0 0 3

CLASSIFICATION OF SIGNALS AND SYSTEMS 9

Continuous time signals (CT signals) – Discrete time signals (DT signals) – Step, Ramp, Pulse, Impulse, Exponential – classification of CT and DT signals – periodic and aperiodic signals – Random signals, Energy and Power signals – CT systems and DT systems – Classification of systems

ANALYSIS OF CONTINUOUS TIME SIGNALS 9

Fourier series analysis – Spectrum of Continuous Time (CT) signals – Fourier and Laplace transforms in Signal Analysis

LINEAR TIME INVARIANT – CONTINUOUS TIME SYSTEMS 9

Differential Equation – Block diagram representation – Impulse response – Convolution integrals – Fourier and Laplace transforms Analysis

ANALYSIS OF DISCRETE TIME SIGNALS 9

Baseband Sampling of CT signals – Aliasing, Reconstruction of CT signal from DT signal – DTFT and properties – Z-transform and properties

LINEAR TIME INVARIANT –DISCRETE TIME SYSTEMS 9

Difference Equations – Block diagram representation – Impulse response – Convolution sum – DTFT and Z Transform analysis of Recursive and Non-Recursive systems

Total: 45 Periods

TEXT BOOKS

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson,Indian Reprint, 2007.

2. P.Ramakrishna Rao, “Signals and Systems” , Tata Mc Graw Hill Publications, 2008.

3. B. P. Lathi, “Principles of Linear Systems and Signals”, Oxford, Second Edition, 2009.

REFERENCE BOOKS

1. H P Hsu, “Signals and Systems”, Schaum’s Outlines, Tata McGraw Hill, 2006.

2. Edward W. Kamen, Bonnie S. Heck, “Fundamentals of Signals and Systems using the Web and MATLAB”, Pearson, Indian Reprint, 2007.

3. John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.

4. M.J.Roberts, “Signals & Systems, Analysis using Transform methods & MATLAB”, Tata McGraw Hill (India), 2007.

EC904 ADVANCED NETWORK ANALYSIS **L T P C**
3 0 0 3

FUNDAMENTLS **9**

Basic Circuit Elements – Network Classification – Perfect Transformer – Sources – Source Transformation – Dot Convention for Coupled Circuits – Network Equations – Loop Analysis – Nodal Analysis – Network Theorems – Graph Theory: Incidence Matrix – Loop Matrix – Cut Sets – Generalized Elements.

MATHEMATICAL CONCEPTS **9**

Homogeneous and Non-Homogeneous Equations – Initial Conditions in Circuits – First Order and Second Order Circuits – Fourier Series: Even and Odd Functions – Half wave Symmetry – Exponential Fourier Series – Change of Interval – RMS Value of a Function – Fourier Transform – Transform of an Impulse Function – Duality – Laplace Transform – Properties – Laplace Transform of Some Typical Functions – Operational Representation of Circuit Elements – Application of Laplace Transform to Electric Networks.

NETWORK FUNCTIONS AND RESONANCE **9**

Driving Point and Transfer Functions – Two Port Networks – Interconnection of Two Port Networks – Poles and Zeros of Network Functions – Series Resonance – Parallel Resonance – Quality Factor of RLC Circuits – Poles-Zero Configuration of RLC Circuits.

CLASSICAL FILTERS **9**

Attenuators – Propagation Function – Balanced and Unbalanced Networks – Lattice Attenuation – Insertion Loss – Classification of Filters – Characteristic Impedance – Low Pass and High Pass Constant-k Filters –Band Pass Filter –m-Derived Filter - Composite Filter.

MODERN FILTER THEORY AND ACTIVE RC FILTERS **9**

Butterworth Approximation – Chebychev Approximation – Active Elements and Circuits: VCT, VVT, CCT, CVT – Nullator and Norator – Filter Design – Second Order Low Pass Filter - Second Order High Pass Filter - Second Order Band Pass Filter – Pole-Zero Sensitivity.

Total: 45 Periods

TEXT BOOK

1. C.L.Wadhwa, "Network Analysis and Synthesis", Second Edition, New Age International Publishers, 2006.

REFERENCE BOOKS

1. Franklin F.Kuo, "Network Analysis and Synthesis", Second Edition, John Wiley & Sons, 2009.

2. Louis Weinberg, "Network Analysis and Synthesis", R.E.Krieger Publishers, 1975.

EC907 ANTENNA AND WAVE PROPAGATION **L T P C**
3 0 0 3

FUNDAMENTALS OF RADIATION 9

Definition of antenna parameters: Gain, Directivity, Effective aperture, Radiation Resistance, Band width, Beam width, Input Impedance – Matching – Baluns, Polarization mismatch – Antenna noise temperature from oscillating dipole, Half wave dipole, Folded dipole – Yagi array

APERTURE AND SLOT ANTENNAS 9

Radiation from rectangular apertures – Uniform and Tapered aperture – Horn antenna, Reflector antenna – Aperture blockage – Feeding structures– Slot antennas – Microstrip antennas – Radiation mechanism – Application – Numerical tool for antenna analysis

ANTENNA ARRAYS 9

N element linear array – Pattern multiplication – Broadside and End fire array – Concept of Phased arrays, Adaptive array – Basic principle of antenna Synthesis – Binomial array

SPECIAL ANTENNAS 9

Principle of frequency independent antennas – Spiral antenna, Helical antenna, Log periodic – Modern antennas – Reconfigurable antenna – Active antenna – Dielectric antennas – Electronic band gap structure and applications – Antenna Measurements – Test Ranges, Measurement of Gain, Radiation pattern, Polarization, VSWR

PROPAGATION OF RADIO WAVES 9

Modes of propagation – Structure of atmosphere – Ground wave propagation, Tropospheric propagation , Duct propagation, Troposcatter propagation – Flat earth and Curved earth concept – Sky wave propagation – Virtual height – Critical frequency, Maximum usable frequency – Skip distance, Fading, Multi hop propagation

Total: 45 Periods

TEXT BOOKS

1. John D Kraus, “Antennas for all Applications”, 3rd Edition, McGraw-Hill, 2005.

2. Edward C.Jordan and Keith G.Balmain “Electromagnetic Waves and Radiating Systems”, Prentice Hall of India, 2006.

3. R.E.Collin, “Antennas and Radiowave Propagation”, McGraw-Hill, 1985.

REFERENCE BOOKS

1. Constantine.A.Balanis, "Antenna Theory Analysis and Design” Wiley student Edition, 2006.

2. Rajeswari Chatterjee, "Antenna Theory and Practice”, Revised Second edition” New Age international Publishers, 2006.

3. S.Drabowitch, ”Modern Antennas”, Second Edition, Springer Publications, 2007.

4. Robert S.Elliott, "Antenna theory and Design”, Wiley student edition, 2006

5. H.Sizun, "Radio Wave Propagation for Telecommunication Applications”, First Indian Reprint, Springer Publications, 2007.

EC305 MEASUREMENTS AND INSTRUMENTATION LABORATORY

L	T	P	C
0	0	2	1

1. Study of Displacement and Pressure Transducers and their characterization
2. Measurement of passive elements using Bridge Networks - AC Bridges (Schering, Anderson and Maxwell Bridges).
3. Measurement of passive elements using Bridge Networks - DC Bridges (Wheatstone Bridge and Kelvin's Bridge).
4. Instrumentation Amplifiers.
5. A/D and D/A converters.
6. Calibration of Single-Phase Energy Meter
7. Calibration of Current Transformer
8. Measurement of Three-Phase Power and Power Factor
9. Measurement of iron loss.
10. Design of signal conditioning circuits
11. Measurement systems - Simulation & analysis using LABVIEW

EC306 DIGITAL COMMUNICATION LABORATORY

L	T	P	C
0	0	3	2

4. Signal Sampling and Reconstruction
5. Amplitude modulation and Demodulation.
6. Frequency Modulation and Demodulation
7. Pulse Modulation – PAM / PWM / PPM
8. Pulse Code Modulation
9. Delta Modulation, Adaptive Delta Modulation.
10. Digital Modulation & Demodulation – ASK, PSK, QPSK, FSK (Hardware & MATLAB)
11. Designing, Assembling and Testing of Pre-Emphasis / De-emphasis Circuits.
12. PLL and Frequency Synthesizer
13. Line Coding
14. Error Control Coding using MATLAB.
15. Spread Spectrum Communication (Simulation)
16. Communication Link Simulation
17. Sampling & Time Division Multiplexing.
18. Frequency Division Multiplexing.
19. Symbol Timing Synchronization.
20. Equalization – Zero Forcing & LMS Algorithms.

EC307 NETWORKS LABORATORY

L	T	P	C
0	0	3	2

1. PC to PC Communication
2. Parallel Communication Using 8 Bit Parallel Cable
3. Serial Communication Using RS 232C
4. Ethernet LAN Protocol
5. To Create Scenario and Study the Performance of CSMA / CD Protocol through Simulation
6. Token Bus and Token Ring Protocols
7. To Create Scenario and Study the Performance of Token Bus and Token Ring Protocols Through Simulation
8. Wireless LAN Protocols
9. To Create Scenario and Study the Performance of Network with CSMA / CA Protocol and Compare with CSMA/CD Protocols.
10. Implementation and Study of Stop and Wait Protocol
11. Implementation and Study of Goback–N and Selective Reject Protocols
12. Implementation of Distance Vector Routing Algorithm
13. Implementation of Link State Routing Algorithm
14. Implementation of Data Encryption and Decryption
15. Transfer of Files From PC to PC Using Windows / UNIX Socket Processing

Department of Electronics and Communication Engineering

Semester VI

Course Code	Course Title	L	T	P	C
EC351	Embedded Systems	3	0	0	3
EC352	Digital Signal Processing	3	0	0	3
EC353	Transmission Lines and Wave Guides	3	0	0	3
EC354	VLSI System Design and Modeling Techniques	3	0	0	3
EC910	Mobile Communication	3	0	0	3
EC911	Wireless Sensor Networks	3	0	0	3
EC355	Digital Signal Processing Laboratory	0	0	3	2
EC356	Embedded Systems Laboratory	0	0	3	2
EC357	VLSI Design Laboratory	0	0	3	2
TOTAL		**18**	**0**	**9**	**24**

EC351 EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

Definitions, Challenges and Architecture **9**

Basic concepts of Embedded Systems - Complex Systems and Microprocessors – Characteristics of Embedded Computing Applications – Real Time Systems – Challenges in Embedded System Design - Embedded System Design Process

Implementation Platform for Embedded Computing **9**

Processing Elements for Building Embedded Systems – Real World Interface – Communication Interface – 8051 Microcontroller – Instruction Set and Programming – Parallel Ports – Timers and Serial Ports – Addressing Modes – Interfacing with Memory and I/O – Interrupt Handling - ARM Core based Embedded Computing - ARM7 and ARM9 - ARM Instruction Set and Programming – Optimization

Abstraction Layer (OS / RTOS) **9**

Tasks, Processes and Threads – Preemptive and Non-Preemptive Multitasking - Context switching – Scheduling policies – Inter Process Communication – Semaphores – Mutex and Deadlocks - Performance issues - Need for RTOS - Introduction to µC/OS II – System Level Functions – Task Service Functions – Memory Allocation Functions – Case Studies of Programming with RTOS

Programming Embedded Systems in C **9**

Programming using µC/OS II functions - Inline Functions and Inline Assembly – Portability issues - Meeting Real Time constraints - Multi-State Systems and Function Sequences - Program Optimization – Performance Analysis – Performance Optimization Strategies – Program Level Energy and Power Analysis – Optimization of Program Size – Program Validation and Testing

Development and Deployment of Embedded Systems **9**

Embedded software development tools – Emulators and Debuggers - Embedded System Design Process - Design Flow – Requirement Analysis – Specifications – Control-Oriented Specification Language – System Analysis and Architectural Design – Quality Assurance – Design Examples: Alarm Clock – Elevator Controller – Telephone Answering Machine - Set-Top-Box

Total: 45 Periods

Text Books

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education, Second edition, 2006

2. Wayne Wolf, "Computers as Components - Principles of Embedded Computer System Design", 2nd Edition, Morgan Kaufmann Publisher, 2008.

Reference Books

3. David E-Simon, "An Embedded Software Primer", Pearson Education, 2007.

4. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Dreamtech Press, 2005.

5. Arnold S Berger, "Embedded System Design: An Introduction to Processes, Tools and Techniques", CMP Books, 2002.

6. Sriram V Iyer and Pankaj Gupta, "Embedded Real Time Systems Programming", Tata McGraw-Hill, 2004.

7. Jean J Labrosse, "Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C", 2nd Edition, CMP Books, 2000.

8. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide: Designing and Optimizing System Software", Morgan Kaufmann Publishers / Elsevier, 2006.

EC352 DIGITAL SIGNAL PROCESSING **L T P C**

3 0 0 3

Fast Fourier Transform **9**

Frequency Domain Sampling and DFT - Properties of DFT - Linear Convolution using DFT - Efficient computation of DFT of two real Sequences. Efficient computation of the DFT of a 2-N point Real Sequences - Fast Fourier Transform Algorithms - Radix-2 FFT algorithms – Decimation in Time algorithms – Decimation in Frequency algorithms – Use of FFT algorithms in Linear Filtering and Correlation - Application to Convolution, Overlap-add & Overlap-save methods.

IIR Filter Design Techniques **9**

Calculation of IIR coefficients using Pole-Zero Placement Method - Analog filters – Butter Worth Filter - Chebyshev Filter - Analog Transformation of prototype LPF to BPF /BSF/ HPF - Transformation of analog filters into equivalent digital filters using Impulse Invariant Method and Bilinear Z transform method - Realization structures for IIR filters – direct, cascade, parallel & lattice forms.

FIR Filter Design Techniques **9**

Linear phase response of FIR - FIR design using window method - Rectangular Window, Hanning Window, Hamming Window, Blackman Window and Bartlett Window -Frequency Sampling Method - Realization structures for FIR filters – Transversal and Linear phase lattice structures - Comparison of FIR and IIR.

Quantization Effects **9**

Representation of numbers - ADC Quantization Noise - Coefficient Quantization Error -Product Quantization Error - Truncation & Rounding Errors - Limit Cycle due to Product Round-off Error – Round-off Noise Power - Limit Cycle Oscillation due to overflow in digital filters – Principle of Scaling.

Multirate Signal Processing **9**

Introduction to Multirate signal processing – Decimation - Interpolation - Polyphase Decomposition of FIR filter - Multistage implementation of sampling rate conversion -Design of narrow band filters - Applications of Multirate signal processing.

Total: 45 Periods

Text Books

6. John.G. Proakis and Dimitris G Manolakis, "Digital Signal Processing: Principles Algorithms and Applications", 4th Edition, Pearson Education, 2007.

7. Sanjit K.Mitra, "Digital Signal Processing: A Computer-Based Approach", 4th Edition, McGraw-Hill Higher Education, 2011.

Reference Books

3. Alan V. Oppenheim and Ronald W. Schafer, "Digital Signal Processing", Prentice -Hall, 1975.

4. S.Salivahanan, A.Vallavaraj, C. Gnanapriya, "Digital Signal Processing", Tata McGraw-Hill, 2000

5. Lawrence R. Rabiner and Bernard Gold, "Theory and Application of Digital Signal Processing", Prentice-Hall, 1975.

6. Avtar Singh and S.Srinivasan, "Digital Signal Processing Implementations: using DSP microprocessors with examples from TMS320C54XX", Thomson / Brooks / Cole Publishers, 2004.

EC353 TRANSMISSION LINES AND WAVE GUIDES

L	T	P	C
3	0	0	3

Transmission Line Theory **9**

Introduction to different types of Transmission Lines - Transmission Line Equation - Solution – Infinite Line concept - Distortionless Line – Loading – Input Impedance - Losses in Transmission Lines– Reflection Loss - Insertion Loss - Return Loss - Transmission Line parameters at radio frequencies – Telephone Cable – Inductance Loading of Telephone Cable – T and π Section Equivalent to Lines - Introduction to Planar Transmission Lines.

Impedance Matching and Transformation **9**

Reflection Phenomena - Standing waves - Standing Wave Ratio - λ/8, λ/4 & λ/2 Lines - λ/4 Impedance Transformers - Circle Diagram for the Dissipationless Line - Smith Chart and Applications – Impedance to Reflection Coefficient conversion and vice versa – Impedance to Admittance Conversion and vice versa - Stub Matching – Single and Double Stub Matching.

Network Components **9**

Filter Fundamentals - Constant K - LPF and HPF Filter design - Fundamentals of Attenuators and Equalizers – Lattice type - Concept of Inverse Networks - Transients in Transmission Lines.

Rectangular Wave Guides **9**

Transverse Magnetic and Electric Waves - Waves between Parallel Planes Characteristics of TE, TM and TEM Waves - Velocities of propagation - Solution of Wave Equation in Rectangular Guides - TE and TM modes - Dominant Mode – Attenuation - Mode Excitation - Dielectric Slab Wave Guides.

Cylindrical Wave Guides and Resonators **9**

Bessel Function - Solution of Wave Equation in Circular Guides - TE and TM waves in Circular Guides - Wave Impedance - Attenuation - Mode Excitation - Formation of Cylindrical Cavity – Microwave Cavities - Cavity Resonators - Q Factor of Cavity Resonators.

Total: 45 Periods

Text Book

4. John D. Ryder, "Networks, Lines and Fields", 2nd Edition, PHI Learning, 1999.

Reference Books

5. E.C.Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd Edition, PHI Learning, 2009.

6. Joseph Edminister, "Schaum's Outline of Electromegnetics", 3rd Edition, McGraw Hill Professional, 2010.

7. G. S. N. Raju, "Electromagnetic Field Theory and Transmission Lines", Pearson Education, 2006.

EC354 VLSI SYSTEM DESIGNAND MODELING TECHNIQUES

L	T	P	C
3	0	0	3

CMOS Technology Fundamentals **9**

CMOS circuit basics - MOSFET Pass Characteristics – Integrated Circuit Layers - Measuring Squares - Electrical Properties of Silicon - Doped and Un-doped Semiconductors - Conduction in Silicon Devices - MOSFET Gate Operation - Physical NMOS and PMOS Devices - Lower CMOS layers - Physical Realization of a Four Terminal MOSFETs - CMOS Device Dimensions - Upper CMOS Layers - Inverter Layout - CMOS Layout Layers - Series MOSFET Layout - Parallel MOSFET Layout

CMOS Fabrication Process **9**

Wafer Growth - Photolithography - Diffusion - Ion Implantation - Oxidation - Deposition - Etching - Epitaxial Growth - Multi-Functional Cells - Complex Intra-Cell Routing - Mapping Schematics to Layout - Stick Diagram - Euler Path - Building Large Transistors - Hierarchical Design - Cell Concept - Cell View and Ports - Cell Layout Guidelines - Design Rules - Substrate / Well Contacts - Latch Up - Multiple Contacts

VLSI Logic Circuits and Analysis **9**

Switch-Level Boolean Logic - CMOS Push-Pull Logic - Creating Logic Gates in CMOS - CMOS Inverter - NMOS Logic Gates - CMOS NOR Gate - CMOS NAND Gate - 3-Input Gate - Complex Combinational Logic - De-Morgan Rules for Constructing CMOS Gates – MOS Device Design Equations – MOS Models - Structured Logic - AOI / OAI NMOS Circuits - AOI / OAI PMOS Circuits - Implementing Logic in CMOS - XOR and XNOR - AOI Schematic - CMOS Transmission Gate - Transmission Gate Logic functions - Power Dissipation

Physical Design **9**

Large Scale Physical Design – Device Models - System Design Considerations - Interconnect Delay Modelling – Crosstalk – Interconnect scaling – Device Characterization – Circuit Characterization – Input and Output Circuits – Power

Distribution and Consumption – Low Power Design Considerations – Clocked Flip-Flops – Pipelined Systems – Clock Generation and Distribution

System Design Using Programmable Array Logic **9**

Circuit and System Representation – Hierarchical Representation of Digital System – Evolution of Programmable Logic – PLA, PAL, CPLD and FPGA – Design Approach - HDL: Basic Concepts – Procedures and Assignments – Timing Controls – Delay – Tasks and Functions - Gate-Level Modelling – Switch-Level Modelling – Behavioural and RTL Modelling – Subsystem Design: Parity Generators, Comparators, Zero/One Detectors, Counters, Shifters, Adders, Multipliers, ALUs and High Density Memory Elements – System Design using Programmable Logic.

Total: 45 Periods

Text Books

1. J.P. Uyemura, "Introduction to VLSI circuits and systems", John Wiley & Sons, 2002.

2. Douglas A. Pucknell and Kamran Eshraghian, "Basic VLSI Design: Principles and Applications", Prentice-Hall, 1985.

Reference Books

5. Wayne Wolf, "Modern VLSI Design: IP-Based Design", Fourth Edition, Pearson Education, 2009.

6. Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL", Second Edition, Prentice Hall, 2010.

7. Neil H.E. Weste, David Harris and Ayan Banerjee, "CMOS VLSI DESIGN: A Circuits and Systems Perspective", Third Edition, Pearson Education, 2005.

EC901 MOBILE COMMUNICATION **L T P C**

3 0 0 3

INTRODUCTION TO MOBILE COMMUNICATION SYSTEM 9

Evolution of Mobile Radio Communications, Examples of Wireless Communication Systems, Second Generation (2G)Cellular Networks, Third Generation(3G) Wireless Networks. The Cellular Concept: Frequency reuse, Channel Assignment Strategies, Interference and system capacity, Trunking and Grade of Service, Improving Coverage and capacity in Cellular systems (Cell Splitting, Sectoring, A Microcell Zone Concept)

MOBILE RADIO PROPAGATION 9

Introduction to Radio Wave Propagation, Free space propagation model, Three Basic Propagation Mechanisms(reflection, diffraction, scattering), Outdoor Propagation models, Indoor propagation models, Small-Scale Multipath propagation, Impulse Response Model of a Multipath Channel, Small-Scale Multipath Measurements, Parameters of Mobile multipath channels, Types of small scale fading, Flat Fading, Frequency Selective Fading, Fast Fading , Slow Fading.

MODULATION TECHNIQUES FOR MOBILE RADIO 9

Linear Modulation Techniques(BPSK, DPSK, QPSK, Offset QPSK), Constant Envelope Modulation (BFSK, MSK, GMSK), Combined Linear and Constant Envelope Modulation Techniques (Minimum Shift Keying, Gaussian MSK, M-ary QAM, M-ary FSK, Orthogonal Frequency Division Multiplexing), Spread Spectrum Modulation Techniques, Pseudo-Noise(PN) Sequence, Direct Sequence Spread Spectrum,(DS-SS), Frequency Hopped Spread Spetrum(FH-SS),Performance of DS-SS and Performance of FH-SS.

MULTIPLE ACCESS TECHNIQUES 9

Multiple Access Techniques: Frequency Division Multiple Access(FDMA), Time Division Multiple Access(TDMA), Spread Spectrum Multiple Access, Frequency Hopped Multiple Access(FHMA) and Code Division Multiple Access(CDMA), Space Division Multiple Access(SDMA),Packet Radio Protocols, Pure ALOHA, Slotted ALOHA, Capacity of Cellular Code Division Multiple Access and Space Division Multiple Access.

WIRELESS SYSTEMS AND STANDARDS 9

Global System for Mobile(GSM), GSM Services and Features, GSM System Architecture, GSM Radio Subsystem, GSM channels, GSM Traffic Channels and GSM Control Channels, Frame structure for GSM, Signal Processing in GSM , CDMA Digital Cellular Standard, Frequency and Channel Specifications, Forward CDMA Channel, Reverse CDMA Channel

TEXT BOOKS:

1. T S Rappaport, Wireless Communications, Pearson Education, India

2.Upen Dalal, Wireless Communication, Oxford University Press,2010

REFERENCE BOOKS:

1. W C Y Lee, Mobile Communication Engineering – Theory and Applications; TMH

2. Jochen Schiller, “Mobile Communications”, Second Edition, Pearson Education, 2003.

3. William Stallings, “Wireless Communications and Networks”, Pearson Education, 2002.

4. T L Singhal, Wireless Communications, Tata McGraw Hill 2010.

5. V K Garg, Wireless Communication and Networking; Morgan Kaufman Publishers India; 2008

EC911 WIRELESS SENSOR NETWORKS **L T P C**
3 0 0 3

Fundamentals **9**

Introduction to Sensor Networks - Unique constraints and challenges - Advantage of Sensor Networks - Applications of Sensor Networks - Cellular and Mobile Adhoc NETworks (MANETs) - Enabling technologies for Wireless Sensor Networks – Key Definitions of Sensor Networks – Collaborative Processing.

Architectures **9**

Sensor Node Hardware and Network Architecture: Single-Node Architecture - Hardware components & Design constraints - Operating Systems and Execution Environments - Network architecture - Physical Layer and Transceiver Design Considerations - Optimization goals and figures of merit - Design principles for WSNs - Service interfaces of WSNs - Gateway concepts.

Networking Sensors **9**

Sensor Management Network Protocols - MAC Protocols - Issues in designing MAC Protocol for WSNs - Classification of MAC Protocols - S-MAC Protocol - B-MAC protocol - IEEE 802.15.4 standard - Zig Bee - Dissemination protocol for large sensor network - Routing protocols: Issues in designing routing protocols - Classification of routing protocols - Energy-efficient routing - Unicast - Broadcast - Multicast - Geographic routing.

Infrastructure Establishment **9**

Topology control - Clustering - Time Synchronization - Deployment and Configuration: Localization and positioning - Coverage and connectivity - Single-hop and multi-hop localization - Self configuring localization systems - Roles of Sensor Nodes and Utilities – Sensor Tasking and Control.

Sensor Network Platforms and Tools **9**

Data Storage and Manipulation: Data Centric and Content Based Routing - Compression Technologies for WSN - Data Aggregation Technique - Applications: Detecting unauthorized activity using a Sensor Network - WSN for Habitat Monitoring - Operating Systems for Wireless Sensor Networks - Introduction to TinyOS and nesC - Berkeley Motes - Programming Challenges - Node Level Software Platforms - Node Level Simulators - State-centric Programming.

Total: 45 Periods

Text Books

5. Holger Kerl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, 2005.

6. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks: An Information Processing Approach", Elsevier, 2007.

Reference Books

2. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.

3. Bhaskar Krishnamachari, "Networking Wireless Sensors", Cambridge University Press, 2005.

4. C. Siva Ram Murthy and B. S. Manoj, "Adhoc Wireless Networks: Architectures and Protocols", Prentice Hall, 2004.

5. Kazem Sohraby, Daniel Minoli and Taieb Znati, "Wireless Sensor Networks - Technology, Protocols, and Applications", John Wiley, 2007.

6. Wayne Tomasi, "Introduction to Data Communication and Networking", Pearson Education, 2007.

EC355 DIGITAL SIGNAL PROCESSING LABORATORY

L	T	P	C
0	0	3	2

USING DSP TRAINER

5. Study of various Addressing modes of DSP with simple programming examples using TMS320C5X, TMS320C67XX, ADSP 21XXX, BF53X
6. Implementation of Linear and Circular Convolution
7. Sampling of Input Signal and Display
8. Waveform Generation
9. Calculation of FFT
10. Implementation of FIR and IIR Filters

USING MATLAB

5. Linear and Circular convolution of two sequences
6. Noise cancellation of Signal
7. Long Sequence convolution (Overlap add & save method)
8. Design of FIR Filters
9. Design of IIR Filters
10. Calculation of FFT of a Signal
11. Decimation by poly-phase decomposition

HARDWARE IN LOOP EXPERIMENTS

21. Implement a 2nd Order LPF in Simulink and download it to C6747 and draw the LPF Frequency Response
22. Develop a Simulation block for Real Time convolution of two input signals and download the code to C6747 Kit

EC356 EMBEDDED SYSTEMS LABORATORY

L	T	P	C
0	0	3	2

Use of C Language – Use of an IDE (KEIL / IAR)

Processors: MCS51, ARM7 and ARM9

Exercises based on the above

4. Data transfer programs
5. Arithmetic and logical programs
6. Conversions and sorting
7. Timers and Interrupts
8. Serial Communication
9. I/O interfacing: Traffic Generator, DAC, ADC
10. Interfacing with Sensor and Actuators – Stepper Motor – DC Motor
11. Execution Time Optimization using Assembly and C

Embedded System Development and Deployment

- Set-Top-Box
- Alarm Clock
- Telephone Answering Machine

EC357 VLSI Design Laboratory

L	T	P	C
0	0	3	2

16. Study of Simulation Tools
17. Design of Traffic Light Controller Using Verilog and Simulation tools
18. Design and Simulation of Pipelined Serial and Parallel Adder to Add/Subract 8 Bit Number of Size, 12 Bits Each in 2's Complement
19. Design Entry and simulation of sequential logic circuits (counters, PRBS generators, accumulators)
20. Study of FPGA Board and Testing on Board LEDs and Switches Using Verilog Codes
21. Testing the Traffic Controller Design Developed in SI. NO.2 on the FPGA Board
22. Design a Realtime Clock (2 Digits, 7 Segments LED Displays Each for HRS., MTS, And SECS.) and Demonstrate its Working on the FPGA Board (An Expansion Card is Required for the Displays) / RTC Chip Based
23. Layout of Simple CMOS inverter parasitic extraction and simulation
24. Design of a 10 bit number controlled oscillator using standard cell approach simulation followed by study of synthesis reports
25. Design of 4 Bit Arithmetic and Logic Unit
26. Design of Memory and Memory Controller
27. Design of Data Acquisition Module and Logger

Semester VII

Course Code	Course Title	L	T	P	C
EC401	Optoelectronics and Optical Communication	3	0	0	3
EC402	RF and Microwave Engineering	3	0	0	3
EC905	Process and Fabrication Technology	3	0	0	3
EC908	Digital Image Processing	3	0	0	3
EC403	Optical and Microwave Laboratory	0	0	3	2
EC404	Project Phase - I	0	0	8	4
TOTAL		**12**	**0**	**11**	**18**

EC401 OPTO ELECTRONICS AND OPTICAL COMMUNICATION L T P C
3 0 0 3

FUNDAMENTALS OF LIGHT, DISPLAY DEVICES AND LASERS 9

Wave Nature of Light – Polarization - Interference - Diffraction - Photo, Electro and Cathode Luminescence - Injection Luminescence - LED - Plasma Display - Liquid Crystal Display - Laser Emission - Absorption - Radiation - Population Inversion - Classes of Lasers - Mode Locking - Laser Applications

OPTICAL FIBERS 9

Light Propagation in Optical Fibers – Ray and Mode Theory of Light – Optical Fiber Structure and Parameters – Fiber Materials - Fiber Fabrication Techniques – Optical Signal Attenuation Mechanisms – Merits and Demerits of Guided and Unguided Optical Signal Transmissions

TRANSMISSION CHARACTERISTICS 9

Optical signal distortion – Group Delay - Material Dispersion - Waveguide Dispersion - Polarization Mode Dispersion - Intermodal Dispersion - Profile Dispersion – Fiber types - Standard Single Mode Fibers - Dispersion Shifted Fibers - Dispersion Flattened Fibers - Polarization Maintaining Fibers - Dispersion Compensation – Fiber nonlinearities - Optical Fiber Connectors - Fiber Alignment and Joint Losses - Fiber Couplers.

OPTICAL TRANSMITTERS AND RECEIVERS 9

Materials for optical sources: Light Emitting Diodes - Semiconductor Laser Diodes – Injection Laser Diode - Longitudinal Modes - Gain and Index Guiding – power-current characteristics - Principles of optical detection – Spectral Responsivity – PIN Photo Detectors - Avalanche Photo Diode – Preamplifier types – Receiver noises – Signal to Noise Ratio (SNR) and Bit Error Rate (BER) – Principles of Coherent Detection – Link Power and Rise Time Budget

OPTICAL NETWORKING PRINCIPLES AND COMPONENTS 9

Network Components: Optical couplers, Filters, Isolators, Switches – Optical amplifiers: Erbium doped Fiber Amplifiers, Semiconductor Optical Amplifiers – Networking Concepts: SONET / SDH / FDDI Optical Networks – WDM optical networks – Layered Optical Network Architecture - Wavelength Routed Networks - Ultra High Capacity Networks.

Total: 45 Periods

TEXT BOOKS

5. Jasprit Singh, "Opto Electronics - An Introduction to Materials and Devices", McGraw-Hill, 1998.

6. Gerd Kaiser , “Optical Fiber Communications”, 4th edition, Sixth reprint, Tata McGraw-Hill, 2009.

REFERENCE BOOKS

1. S.C.Gupta, "Opto Electronic Devices and Systems", Prentice Hall of India, 2005.

2. John M. Senior, “Optical Fiber Communications - Principles and Practice”, Third Edition, Pearson Education, 2010.

3. J.Gower, "Optical Communication System", Prentice Hall of India, 2001.

4. R.P.Khare, "Fiber Optics and Optoelectronics", Oxford University Press, 2007.

5. Govind P. Agrawal, “ Fiber-Optic Communication Systems”, Third Edition, John Wiley & Sons, 2004.

6. Rajiv Ramasamy & Kumar N. Sivarajan, “Optical Networks – A Practical Perspective”, Second Edition, Morgan Kauffman, 2002.

EC402 RF AND MICROWAVE ENGINEERING **L T P C**
3 0 0 3

TWO PORT RF NETWORKS - CIRCUIT REPRESENTATION 9

Low Frequency parameters - impedance, admittance, hybrid and ABCD - High Frequency parameters - Formulation of S parameters, properties of S parameters - Reciprocal and Lossless Networks - Transmission Matrix - Component Basics - Wire - Resistor - Capacitor and Inductor - Applications of RF

RF TRANSISTOR AMPLIFIER DESIGN AND MATCHING NETWORKS 9

Amplifier Power Relation - Stability Considerations - Gain Considerations - Noise Figure - Impedance Matching Networks - frequency response, T and π Matching Networks - Microstripline Matching Networks

MICROWAVE PASSIVE COMPONENTS 9

Microwave Frequency Range - Significance of Microwave Frequency Range - Applications of Microwaves - Scattering matrix - Concept of N port scattering matrix representation - Properties of S matrix - S matrix formulation of two-port junction. Microwave junctions - Tee junctions - Magic Tee - Rat Race - Corners - bends and twists - Directional couplers - two hole directional couplers - Ferrites - important Microwave Properties and Applications - Termination - Gyrator- Isolator - Circulator - Attenuator - Phase changer – S Matrix for Microwave Components – Cylindrical Cavity Resonators.

MICROWAVE SEMICONDUCTOR DEVICES 9

Microwave Semiconductor Devices - Characteristics and Application of BJTs and FETs - Principles of Tunnel Diodes - Varactor and Step Recovery Diodes - Transferred Electron Devices - Gunn Diode - Avalanche Transit Time Devices - IMPATT and TRAPATT Devices - Parametric Devices - Principles of Operation - Applications of Parametric Amplifier - Microwave Monolithic Integrated Circuit (MMIC) - Materials and Fabrication Techniques.

MICROWAVE TUBES AND MEASUREMENTS 9

Microwave tubes - High Frequency Limitations - Principle of Operation of Multicavity Klystron - Reflex Klystron - Traveling Wave Tube - Magnetron - Microwave measurements: Measurement of power, wavelength, impedance, frequency, SWR, attenuation, dielectric constant - Q and Phase shift.

TOTAL: 45 Periods

TEXT BOOKS

12. Samuel Y Liao, “Microwave Devices & Circuits” , Third Edition, Pearson Education, 2003.

13. Reinhold.Ludwig and Gene Bogdanov, "RF Circuit Design: Theory and Applications”, Prentice Hall, 2009.

REFERENCE BOOKS

1. Robert.E.Collin, "Foundations for Microwave Engineering", Second Edition, John Wiley & Sons, 2009.

2. Annapurna Das and Sisir K. Das, “Microwave Engineering”, Tata McGraw-Hill Education, 2000.

3. Guillermo Gonzalez, "Microwave Transistor Amplifiers: Analysis and Design", Second Edition, Prentice Hall, 1997.

4. Matthew M.Radmanesh , "Radio Frequency and Microwave Electronics", Prentice Hall, 2001.

5. David M.Pozar, "Microwave Engineering", John Wiley & Sons, Indian Reprint, 2008.

EC905 PROCESS AND FABRICATION TECHNOLOGY **L T P C**
3 0 0 3

IC TECHNOLOGY FUNDAMENTALS 9

Basic Fabrication Steps and their Importance - Clean Room and Safety Requirements - Wafer Cleaning Processes - Wet Chemical Etching Techniques - Electronic Grade Silicon - Czochralski Crystal Growing - Silicon Shaping - Processing Considerations.

EPITAXY AND OXIDATION 9

Epitaxy: Vapor Phase Epitaxy - Molecular Beam Epitaxy - Silicon on Insulators - Epitaxial evaluation - Oxidation: Growth mechanism and Kinetics - Thin Oxides - Oxidation technologies in VLSI and ULSI - Characterization of Oxide Films - Oxide Properties - Redistribution of Dopants at Interface - Oxidation of Polysilicon - Oxidation Induced Defects.

DEPOSITION AND ETCHING 9

Chemical Vapour Deposition Techniques for deposition of Polysilicon, Silicon Dioxide, Silicon Nitride and Metal Films - Metal Film Deposition - Evaporation and Sputtering techniques - Failure mechanisms in Metal Interconnects - Multi-level Metallization schemes - Plasma and Rapid Thermal Processing - PECVD - Plasma Etching and RIE techniques - RTP techniques for Annealing, Growth and Deposition of various films for use in ULSI.

LITHOGRAPHY AND DIFFUSION 9

Photolithography - E-Beam Lithography - X-Ray Lithography - Ion Lithography - Mask Generation - Models of Diffusion in Solids - Fick's One Dimensional Diffusion Equations - Atomic Diffusion Mechanisms - Diffusivities of B, P, As and Sb - Measurement techniques - Diffusion in Polysilicon, SiO_2 - Diffusion Enhancements and Retardations.

ION IMPLANTATION AND VLSI PROCESS INTEGRATION 9

Ion implantation: Range theory, implantation equipment, annealing, shallow junctions, high energy implantation. VLSI process integration of NMOS, CMOS and Bipolar Circuits - Advanced MOS technology.

Total: 45 Periods

TEXT BOOKS

3. S.M.Sze, “VLSI Technology”, 2nd Edition, Tata McGraw-Hill, 2003.

4. C.Y. Chang and S.M.Sze, “ULSI Technology”, McGraw-Hill, 1996.

REFERENCE BOOKS

1. Stephen A. Campbell, “The Science and Engineering of Microelectronic Fabrication”, Second Edition, Oxford University Press, 2001.

2. James D. Plummer, Michael D. Deal, Peter D.Griffin, ”Silicon VLSI Technology: Fundamentals, Practice and Modeling”, 1st Edition, Pearson Education, 2009.

3. Sorab K. Ghandhi, "VLSI Fabrication Principles: Silicon and Gallium Arsenide", 2nd Edition, John & Wiley Sons, 1994.

4. Peter R.Shepherd, "Integrated Circuit: Design, Fabrication and Test", McGraw-Hill, 1996.

EC908 DIGITAL IMAGE PROCESSING **L T P C**
3 0 0 3

FUNDAMENTALS **9**

Steps in Digital Image Processing - Human Eye and visual perception - Brightness - Contrast - Hue - Saturation - Basic Relationship among Pixels: neighbour, connectivity, regions, boundaries, distance measures - Sampling and Quantization - Elements of Digital Image Processing Systems - Color Image Fundamentals - RGB, HSI models - Two-dimensional Mathematical Preliminaries - 2D Transforms - DFT, DCT, KLT, SVD.

IMAGE ENHANCEMENT **9**

Spatial Domain - Gray Level Transformations - Histogram Equalization and Specification Techniques - Arithmetic / Logical Operations - Spatial filtering - Median filtering - Frequency Domain - 2-D Fourier Transform - Convolution and Correlation Theorems - Smoothing & Sharpening Spatial Filters - Noise Distribution - Color Image Enhancement**.**

IMAGE RESTORATION **9**

Degradation Model - Unconstrained Restoration - Lagrange Multiplier and Constrained Restoration - Inverse filtering - Wiener filtering - Wavelets - Discrete and Continuous Wavelet Transform - Wavelet Transform in 2D.

IMAGE SEGMENTATION **9**

Discontinuities, Edge Linking and Boundary Detection - Thresholding - Region Based Segmentation - Watershed Algorithm - Introduction to Morphological Operations - Binary Morphology - erosion, dilation, opening and closing operations - Applications - Basic Gray-Scale Morphology Operations - Feature Extraction - Object Recognition.

IMAGE COMPRESSION **9**

Redundancies - Coding - Fidelity, Source and Channel Encoding - Elements of Information Theory - Lossless and Lossy Compression - Run Length Coding, Differential Encoding - DCT - Vector Quantization - Entropy Coding - LZW Coding; - Image Compression Standard: JPEG, JPEG 2000, MPEG - Video compression.

Total: 45 Periods

TEXT BOOKS

15. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson, Second Edition, 2004.

16. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson, 2002.

REFERENCE BOOKS

3. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education, Inc., 2004.

4. D, E. Dudgeon and RM. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference, 1990.

5. William K. Pratt, "Digital Image Processing", John Wiley, New York, 2002.

EC403 OPTICAL AND MICROWAVE LABORATORY

L	T	P	C
0	0	3	2

MICROWAVE EXPERIMENTS

5. Reflex Klystron – Mode characteristics
6. Gunn Diode – Characteristics
7. VSWR, Frequency and Wave Length Measurement
8. Directional Coupler – Directivity and Coupling Coefficient – S-parameter measurement
9. Isolator and Circulator – S-parameter measurement
10. Attenuation and Power measurement
11. S - matrix Characterization of E-Plane T, H-Plane T and Magic T.
12. Radiation Pattern of Antennas
13. Antenna Gain Measurement

OPTICAL EXPERIMENTS

14. DC characteristics of LED and PIN Photo Diode.
15. Mode Characteristics of Fibers
16. Measurement of Connector and Bending Losses.
17. Fiber Optic Analog and Digital Link
18. Numerical Aperture Determination for Fibers
19. Attenuation Measurement in Fibers

Department of Electronics and Communication Engineering

Semester VIII

GE451 PROFESSIONAL ETHICS **L T P C**

3 0 0 3

ENGINEERING ETHICS **9**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories

ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as Experimentation – Engineers as responsible Experimenters – Research

Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study 105

ENGINEER'S RESPONSIBILITY FOR SAFETY **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal

RESPONSIBILITIES AND RIGHTS **9**

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) - Discrimination

GLOBAL ISSUES **9**

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct

TOTAL: 45 periods

TEXT BOOKS:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York,

2005.

2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics –

Concepts and Cases", Thompson Learning, 2000.

REFERENCES:

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico,

1999.

2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003

3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists

and Engineers", Oxford University Press, 2001.

4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian

Perspective", Biztantra, New Delhi, 2004.

5. David Ermann and Michele S Shauf, “Computers, Ethics and Society”, Oxford University Press, (2003)

EC907 ANTENNA AND WAVE PROPAGATION L T P C
3 0 0 3

FUNDAMENTALS OF RADIATION 9

Definition of antenna parameters: Gain, Directivity, Effective aperture, Radiation Resistance, Band width, Beam width, Input Impedance – Matching – Baluns, Polarization mismatch – Antenna noise temperature from oscillating dipole, Half wave dipole, Folded dipole – Yagi array

APERTURE AND SLOT ANTENNAS 9

Radiation from rectangular apertures – Uniform and Tapered aperture – Horn antenna, Reflector antenna – Aperture blockage – Feeding structures– Slot antennas – Microstrip antennas – Radiation mechanism – Application – Numerical tool for antenna analysis

ANTENNA ARRAYS 9

N element linear array – Pattern multiplication – Broadside and End fire array – Concept of Phased arrays, Adaptive array – Basic principle of antenna Synthesis – Binomial array

SPECIAL ANTENNAS 9

Principle of frequency independent antennas – Spiral antenna, Helical antenna, Log periodic – Modern antennas – Reconfigurable antenna – Active antenna – Dielectric antennas – Electronic band gap structure and applications – Antenna Measurements – Test Ranges, Measurement of Gain, Radiation pattern, Polarization, VSWR

PROPAGATION OF RADIO WAVES 9

Modes of propagation – Structure of atmosphere – Ground wave propagation, Tropospheric propagation , Duct propagation, Troposcatter propagation – Flat earth

and Curved earth concept – Sky wave propagation – Virtual height – Critical frequency, Maximum usable frequency – Skip distance, Fading, Multi hop propagation

Total: 45 Periods

TEXT BOOKS

1. John D Kraus, “Antennas for all Applications”, 3rd Edition, McGraw-Hill, 2005.

2. Edward C.Jordan and Keith G.Balmain “Electromagnetic Waves and Radiating Systems”, Prentice Hall of India, 2006.

3. R.E.Collin, “Antennas and Radiowave Propagation”, McGraw-Hill, 1985.

REFERENCE BOOKS

1. Constantine.A.Balanis, "Antenna Theory Analysis and Design” Wiley student Edition, 2006.

2. Rajeswari Chatterjee, "Antenna Theory and Practice”, Revised Second edition” New Age international Publishers, 2006.

3. S.Drabowitch, ”Modern Antennas”, Second Edition, Springer Publications, 2007.

4. Robert S.Elliott, "Antenna theory and Design”, Wiley student edition, 2006

5. H.Sizun, "Radio Wave Propagation for Telecommunication Applications”, First Indian Reprint, Springer Publications, 2007.

EC 903 SATELLITE COMMUNICATION **L T P C**

3 0 0 3

INTRODUCTION TO SATELLITE COMMUNICATION 9

Orbital mechanics look angle determination- orbital perturbation- launchers and launch vehicles- orbital effect in communication system performance- satellite subsystem- altitude and orbit control system- telemetry tracking command and monitoring- power system- communication subsystem- satellite antennas.

SATELLITE LINK DESIGN 9

Basic transmission- system noise temperature- G/T ratio- design of down links- satellite system using small earth station- uplink design- design of specified C/N- system design examples.

ERROR CONTROL FOR DIGITAL SATELLITE LINKS 9

Error detection and correction for digital satellite links- channel capacity- error control coding- performance of block error correction codes- convolutional codes- implementation of error detection on satellite links concatenated coding and interleaving- turbo codes.

MULTIPLE ACCESS **9**

Introduction- frequency division multiple access (FDMA)- time division multiple access (TDMA)- onboard processing- demand access multiple access (DAMA)- random access- packet radio systems and protocols- Code division multiple access (CDMA).

VSAT & GPS SYSTEM **9**

Overview of VSAT systems- network architecture- access control protocols- basic techniques- VSAT earth station Engineering.GPS Introduction-- position location principles- Receivers and codes- satellite signal acquisition- GPS Signal Message- signal levels- timing accuracy- GPS receiver operation- GPS C/A code accuracy- differential GPS.

TEXT BOOKS:

1. Timothy Pratt- Charles W Bostian- Jeremy E Allnut, "Satellite Communication" Wiley Edition 2007.

2. Bruce R. Elbert, "The Satellite Communication Applications Hand Book", Artech House Boston,1997.

REFERENCE BOOKS:

1. Wilbur L. Pritchard- Hendri G. Suyderhood, Robert A.Nelson- "Satellite Communication Systems Engineering", 2nd edition, Prentice Hall- New Jersey.1993.

2. Dennis Rody, "Satellite Communication", 4th edition- Regents/Prentice Hall- Eaglewood Cliff-,New Jersey- 2006.