COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF ELECTRONICS
COCHIN – 682 022

Syllabus

M. Sc. (Electronic Science)

2019

M.Sc. ELECTRONIC SCIENCE

Course Structure

Eligible Qualification: **B.Sc. Electronics**

Semester I

Course Code	Course	C/E	Credits
16-305-0101	Electronic Circuits	C	3
16-305-0102	Electronic Circuits Lab	C	2
16-305-0103	Signals & Systems	C	3
16-305-0104	Signals & Systems Lab	C	2
16-305-0105	Digital System Design	C	3
16-305-0106	RF & Microwave Technology	C	3
	Elective I	E	3
	Minimum credits		**19**

List of Electives

Course Code	Course	C/E	Credits
16-305-0107	Computational Techniques	E	3
16-305-0108	Microprocessors & Microcontrollers	E	3

Identified Electives from other Departments as per CBCS*

Course Code	Course	C/E	Credits
	Management for Scientists and Engineers(SMS)	E	3

Semester II

Course Code	Course	C/E	Credits
16-305-0201	Introduction to Embedded Systems	C	3
16-305-0202	Embedded Systems Lab	C	2
16-305-0203	Control Systems	C	3
16-305-0204	Control Systems Lab	C	2
16-305-0205	Digital Signal Processing	C	3
	Elective II	E	3
	Elective III	E	3
	Minimum credits		**19**

List of Electives II & III

Course Code	Course	Pre-requisite	C/E	Credits
16-305-0206	Robotics Technology	18-305-02-03	E	3
16-305-0207	Microwave Integrated Circuits	18-305-01-06	E	3
16-305-0208	Computer Organisation& Architecture		E	3
16-305-0209	Wireless Communication		E	3
16-305-0210	Data Structures		E	3

Identified Electives from other Departments as per CBCS*

Course Code	Course	C/E	Credits
	Number Theory & Cryptography (DCA)	E	3
	Applied Probability & Statistics (DCA)	E	3
	Object Oriented Programming with C++ (DCA)	E	3
	Coding Theory And Cryptography(Maths)	E	3

Semester III

Course Code	Course	C/E	Credits
16-305-0301	Seminar	C	2
18-305-0302	VLSI Design	C	3
16-305-0303	Communication Systems	C	3
16-305-0304	Communications Lab	C	2
	Elective IV	E	3
	Elective V	E	3
	Elective Lab	E	2
	Minimum credits		**18**

List of Electives IV & V

Course Code	Course	Pre-requisite	C/E	Credits
16-305-0305	Robotics and Intelligent Systems		E	3
16-305-0306	Robotics and Intelligent Systems Lab		E	2
16-305-0307	Radar and Satellite Communication		E	3
16-305-0308	Radar and Satellite Communication /Antenna Lab		E	2
16-305-0309	Embedded Software and Real Time Systems		E	3

16-305-0310	Embedded System Design Lab		E	2
16-305-0311	Computer Networks		E	3
16-305-0312	Computer Networks Lab		E	2
16-305-0313	Antennas		E	3

Identified Electives from other departments as per CBCS*

Course Code	Course	C/E	Credits
	Artificial Intelligence (DCA)	E	3
	Wavelet Theory (Maths)	E	3
	Artificial Neural Networks(DCA)	E	3
	Integral Transforms (MATHS)	E	3

Semester IV

Course Code	Course	C/E	Credits
18-305-0401	Project Evaluation and Viva Voce	C	16
	Minimum credits		**16**

Total Credits for the Programme = 19+19+18+16 = 72

16-305-0101: ELECTRONIC CIRCUITS

Course Description:

This course deals with the basic concepts of linear electronic circuits.

Course Objectives:

- To understand the basics of linear electronic systems
- To have a thorough skill in analysis of electronic circuits
- To understand the concept of feedback and oscillators

Course Contents:

Review of active devices: Diodes, BJTs, UJTs, MOSFETs, Insulated Gate Bipolar Transistors Structure, Characteristics, Operation, specifications. Operational amplifiers: parameters and modes of operation

Operational amplifiers : Characteristics, op-amp architecture, Offset and Bias Voltages and Current, Slew Rate, Finite Frequency Response, Gain-bandwidth product, Linear op-amp circuits, Non Linear Op-amp Circuits: Open Loop Comparator, Polarity Indicator, Schmitt Trigger; astable and monostable circuits, Active filters: LPF & HPF using Sallen-Key configuration, Simulation of circuits using LTSPICE

Feedback and Stability: Concept, Negative Feedback Loop, General Requirements of Feedback Circuits, Effect of Feedback on Amplifier, Performance, The four Basic Amplifier types, The four feedback Topologies, Effect of Feedback Connection on Amplifier Port Resistance, Examples of Real Feedback Amplifiers, Feedback Loop Stability. Feedback oscillators; RC phase shift, Colpitts, Hartley, wein bridge, crystal oscillators

Linear circuits: UJT relaxation oscillator, time base generators -bootstrap, miller; blocking oscillators, transient switching and characteristics., voltage regulators, VCO and emitter coupled VCO, Basic PLL topology and principle, transient response of PLL, Linear model of PLL, Major building blocks of PLL – analog and digital phase detector, VCO, filter, Applications of PLL Monolithic PLL - IC LM565 and CD4046 CMOS PLL.

Amplifiers: classification - class A , class B, Class AB, Class C and class D - Transformer coupled Power amplifiers – Transformer less class AB push-pull Power amplifier - complementary symmetry power amplifier - Harmonic distortion in Power amplifiers - Transistor rating -Heat sinks

Text Books:

1. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", McGraw Hill Book Company 1998
2. Ned Mohan et.al, "Power Electronics", John Wiley and Sons, 1989
3. Mark N. Horenstein, "Micro Electronics Circuits and Devices" (Chapter 2 & 10) PHI, 1997.

References:

1. B. Razavi , "Fundamentals of Microelectronics", Wiley
2. Donald A. Neamen, "Electronic Circuit Analysis and Design", 3/e, TMH, 2006
3. Millman J. and C. Halkias, "Integrated Electronics", 2/e, TMH, 2010
4. Spencer & Ghausi: "Introduction to Electronic Circuit Design", Pearson Education, 2003.
5. R. E. Boylstead and L. Nashelsky: "Electronic Devices and Circuit Theory", 10/e, PearsonEducation, 2009.
6. Gaykward, "Operational Amplifiers", Pearson Education, 1999
7. Coughlin R. F. & Driscoll F. F., "Operational Amplifiers and Linear Integrated Circuits", Pearson Education 2002
8. P. S. Bimbhra, "Power Electronics", Khanna publishers, 2012
9. Sen P. C., "Power Electronics", Tata Mc Graw Hill,2003
10. Rashid, "Power Electronics",Prentice Hall India,1993
11. G. K. Dubey et.al, "Thyristorised Power Controllers", Wiley & Sons, 2001
12. Dewan & Straughen, "Power Semiconductor Circuits", Wiley & Sons, 1984
13. Singh M. D. & Khanchandani K. B., Power Electronics, Tata Mc Graw Hill, 1998

16-305-0103: SIGNALS & SYSTEMS

Course Description:

This course deals with the design and analysis of continuous and discrete time signals and systems

Course Objectives:

- To understand the elementary signals and operations on signals
- To familiarize different types of systems
- To analyze continuous and discrete time systems using Fourier transform
- To perform frequency domain analysis of LTI systems
- To have a better idea about Laplace transform and Z-transform with respect to signals and systems

Course Contents:

Elements of signal theory: Signals as functions- Signal taxonomy- basic operations on signals - Some signal models - impulse function, step functions and other singularity functions. Systems : Time-domain representation and analysis of LTI and LSI systems – Convolution - Convolution sum, convolution integral and their evaluation – Causality and stability considerations.

Fourier analysis for continuous time signals and systems: Representation of periodic signals: Continuous Time Fourier Series – convergence of Fourier series – Gibbs phenomenon – Representation of aperiodic signals: Continuous Time Fourier Transform – The Fourier Transform for periodic signals – Properties of Fourier representations – Frequency Response of systems characterized by linear constant coefficient differential equations

Signal Analysis: Signals and vectors – inner product of signals – norm- notion of length of signal and distance between signals– orthogonal signal space – Power spectral density and energy spectral density – Hilbert Transform – In-phase and quadrature representation of band pass signals

Frequency domain analysis of LTI systems: Frequency response Function – signal transmission through a linear system – ideal filters – band width and rise time Sampling: sampling theorem – sampling with Zero Order Hold and reconstruction – interpolation Frequency analysis of discrete time signals and systems – Discrete time Fourier series and Discrete time Fourier Transform – Frequency response function – Discrete Fourier Transform.

Laplace transform: Region of convergence – Analysis of continuous time systems –Transfer function – Frequency response from pole – zero plot. **Z-transform**: Region of convergence – Properties of ROC and Z transform - Analysis of LSI systems - Transfer function- Frequency response from pole – zero plot.

Text Books:

1. Oppenheim A. V., Willsky A. S. &Nawab S. H., "Signals and Systems", Second edition , Tata McGraw Hill, 1996
2. Haykin S. & Veen B. V., "Signals & Systems", John Wiley,1999

References:

1. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2004.
2. Taylor F. H., "Principles of Signals & Systems", McGraw Hill, 1994
3. Lathi B. P., "Modern Digital & Analog Communication Systems", Third edition, OxfordUniversity Press, 2001
4. R. F. Ziemer, W. H. Tranter and D. R. Fannin, "Signals and Systems - Continuous and Discrete", 4thedition., Prentice Hall, 1998
5. Douglas K. Lindner, "Introduction to Signals and Systems", Mc-Graw Hill International Edition,1999.
6. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons (SEA) Private Limited, 1995.
7. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", Tata McGraw Hill Edition, 2003

16-305-0105: DIGITAL SYSTEM DESIGN

Course Description:

This course gives an overview of the design of digital systems. It introduces the basics of combinational and sequential circuits. It provides the concept of state machines and gives an idea of how to model real time scenarios and applications. The course also gives an idea of how to realise the digital system using hardware description language and also provides an overview of programmable logic devices.

Course Objectives:

- To understand the designing of digital systems
- To get an idea about state machines and modeling of systems
- To have an overview of EDA tools
- To understand the realization of digital systems using VHDL

Course Contents:

Review of Digital Systems: Basic Operations, Truth Tables, Laws and Theorems of Boolean algebra Min-term and Max-term Expansions, K-maps, Quine-McCluskey Methods, Review of Combinational logic Circuits- code converters, adder, subtractor, magnitude comparator, decoder, encoder, multiplexer.

Digital Logic Design: Sequential Circuits, Latches, Flip-Flops, **Analysis of clocked** sequential circuits, Mealy and Moore Models, state reduction and assignment, design procedures, excitation tables, state-transition table, state diagram, Finite State Machine design, Registers and Counters, Hazards.

Electronic Design Automation Tools: Introduction to EDA, Overview of VLSI Design flow and levels of abstraction in IC design, Quick tour through design automation at the logic level. Design methodology HDL and top-down design methodology; describe and synthesis approach. Two-level logic synthesis: Multi-level logic synthesis: Boolean networks, transformations on Boolean networks, factoring, algebraic and Boolean division, Kernel-based factoring. Design Cycle, Digital circuit modeling, Design Synthesis and Capture tools, Schematic capture, logic simulation, Simplification of switching functions, computer aided minimizations of switching functions, Modular combination logic, top down modular design, decoders and encoders

Introduction to HDL: Introduction to HDLs, VHDL terms, Object types, Data types, VHDL Operators, Design units in VHDL, Sub programs and Packages, Libraries, IEEE Standard logic, Concurrent Statements, Sequential Statements, Behavioral, Data flow, Structural Modeling, Compilation and Simulation of VHDL Code

System Design using VHDL: Realization of combinational and sequential circuits using HDL, Modeling Flip-Flops, Registers, Counters, Modeling of Combinational logic and Sequential Machine, Modeling of Mealy and Moore finite state machines, Synthesis of VHDL Code. Test bench.

Text Books:

1. Morris Mano, "Digital Logic Design", Fourth Edition, Pearson Publication, 2008
2. Charles H. Roth Jr. "Fundamentals of Logic Design", 5th edition, Cengage Learning 2009
3. Victor P. Nelson, H. Troy Nagle, J. David Irvin, Bill D. Carol, "Digital logic Analysis and design", 1st edition, Prentice Hall Publications

References:

1. Douglas L. Perry "VHDL programming by Example" Tata McGraw.Hill - 2006
2. Nripendra N. Biswas "Logic Design Theory" Prentice Hall of India, 2001
3. Parag K. Lala "Digital system Design using PLD" B S Publications, 2003
4. Stephen D.Brown, Zvonko G.Vranesic, "Fundamentals of Digital Logic with VHDL Design**"**, McGraw-Hill Publications
5. S. Devadas, A. Ghosh, K. Keutzer, "Logic Synthesis", McGraw-Hill Professional, 1994
6. G. D. Hachtel and F. Somenzi, "Logic Synthesis and Verification Algorithms", Kluwer Academic Publishers., 2006
7. G. De. Micheli, "Synthesis and Optimization of Digital Circuits", Kluwer Academic Publishers, 2006

16-305-0106: RF & MICROWAVE TECHNOLOGY

Course Description:

Communication systems, an indispensable part of human life, operate at frequencies in the RF and Microwave range. The basic concepts of RF and microwave components and circuits as well as antennas are covered in this course.

Course Objectives:

- To describe the basic principles of RF and microwave devices and circuits.
- To understand representation of RF and microwave devices by means of S parameters.
- To understand the basic principles of radiation and antennas

Course Contents:

Introduction: Review of Maxwell's equations, boundary conditions, power flow and Poynting vector. Propagation of uniform plane waves in lossy media, conductors and dielectrics, skin depth, polarization, phase velocity and group velocity.

RF Transmission lines: Types of RF transmission lines, sinusoidal steady state excitation, transmission line equations, propagation constants, impedance matching, VSWR. Smith Chart, Microstrip transmission line, TE and TM modes in rectangular waveguide, wave impedance.

Microwave devices: Limitations of conventional tubes at microwave frequencies Velocity modulation, Basic Principles of two cavity Klystron and reflex Klystrons, Principles of operation of Magnetron and Travelling Wave Tubes, Microwave Solid State Devices, Transferred Electron devices, Gunn effect, PIN diode, YIG Devices.

Passive Microwave components: Attenuators, Phase shifters, directional couplers, Hybrid Circuits, Faraday Rotation in Ferrites, Isolator, Circulator, Switch and Modulator, S parameters measurements

Radiation and Antennas: Potential functions, Retarded potential, Radiation mechanism, Antenna structures , Antenna parameters- Gain, directivity, aperture, radiation pattern, types of antennas and applications, Antenna arrays, two element array, broadside and end fire array.

Text Books:

1. Samuel Y. Liao, Microwave Devices and Circuits, Pearson 3rd Edition, 2003
2. K. C. Gupta Microwaves, New Age International Ltd.1995.
3. Rajeshwari Chatterji: Microwave, Millimeter wave and sub-millimeter wave vacuum electron devices, Affiliated East - West Press, 1994

References:

1. Stephen C. C. Harsany: `Principles of Microwave Technology', Prentice Hall, 1997
2. Peter A. Rizzi, Microwave Engineering: Passive Circuits. New Delhi : PHI, 2001
3. Edward C. Jordan, Electromagnetic waves and Radiating Systems. 2nd Edition, Pearson, 2015
4. Robert E. Collin, Foundations for Microwave Engineering, McGraw Hill, 1998
5. D. M. Pazar, Microwave Engineering, 4th edition, John Wiley and Sons (ASIA), 2011
6. Paul C. R. and S. A. Nassar, " Introduction to Electromagnetic fields ", McGraw Hill, 1987

16-305-0107: COMPUTATIONAL TECHNIQUES

Course Description:

This course deals with the basic numerical techniques and C-programming approach to implement the numerical techniques

Course Objectives:

- To have a basic idea of pointers, arrays, structures and basic file handling operations in C
- To familiarize various numerical interpolation techniques
- To understand various numerical methods for solution of linear system of equations
- To study various numerical integration and differentiation techniques
- To develop basic skill in numerical solution of ordinary and partial differential equation

Course Contents:

Pointers and Arrays: Single and multidimensional arrays - Pointers and arrays – address arithmetic - Passing pointers to functions. Structures and Unions: Basics of structures, Structures and functions – Arrays of Structures – Pointers to structures – self referential structures – Type definitions – Unions. Input and Output: Standard input and output – Formatted output – variable length argument list – file access.

Numerical Analysis: Numerical Computations, sources of errors, Numerical solution of algebraic and transcendental equations, bisection method, Newton – Raphson method, iteration methods, polynomial interpolation: Lagrange interpolation polynomial, divided differences, Newton's divided differences interpolation polynomial.

Solution of linear system of algebraic equations: Gauss – Siedel iteration method, Gauss elimination method, Gauss-Jordan method. LU decomposition method. Error equations. Matrix inversion and Eigen value problems.

Numerical integration and differentiation: Trapeziodal rule. Romberg integration, Simpsons rule, numerical differentiation, finite difference methods. Numerical solution of ordinary differential equations: Initial value problems: Euler methods, Modified Euler methods, Runge-Kutta methods. Solution of simultaneous ODE.

Boundary value problems: Numerical solution of boundary value of problems, methods of finite differences, Partial Differential equations, solution of Elliptic, parabolic and hyperbolic PDE.

Text Books:

1. M. K. Jain, S. R. K. Iyengar, R. K. Jain, "Numerical methods for Scientific and Engineering Computation", Wiley Eastern Ltd., 1993.
2. P. Kandaswamy, K. Thilagavathy,"Numerical Methods", S. Chand & Co. 1996

References:

1. M. L. James, G. M. smith and J. C. Walford, "Applied Numerical methods Digital computation", Herper & Tow, 1983.
2. E. V. Krishnamurthy, S. K. Sen, "Numerical Algorithms", Affiliated East West/1001.

16-305-0108: MICROPROCESSORS & MICROCONTROLLERS

Course Description:

This course deals with the basic overview of 8086 microprocessor, MCS51 microcontrollers, programming and interfacing of microprocessors / microcontrollers.

Course Objectives:

- To have a basic overview of ALU, Registers, control logic, bus, I/O Module, Clocking system.
- To understand the basic architecture and instruction set of Intel 8086 microprocessor
- To have a basic awareness in microprocessor interfacing with peripheral chips
- To understand the basic architecture and instruction set of Intel MCS51 family of microcontrollers
- To develop basic skill in designing and programming of microprocessor /microcontroller using assembly language.

Course Contents:

Introduction: History of microprocessors –Basics of computer architecture, the architecture of 8086, buses, memory/I/O mapping, Interrupt system, addressing modes, minimum mode and maximum mode systems.

Instruction set and programming: Instruction set- Instruction format, use of MASM - Programming concepts-Procedures-Macros-ASCII operations-high level language constructs –I/O instructions–Modular programming

Peripheral Interfacing: PPI 8255 – Timer 8253 – Keyboard Display Interface 8279-DMA Controller 8237-Programmable Interrupt Controller 8259, video display interface-6845.

Intel 89C51 microcontroller: architecture, features - internal block schematic – pin descriptions, I/O ports. Memory organization – on chip peripherals, interrupt structure & functioning, Programming model - Program status word - register banks - Addressing modes - instruction set –Programming examples

System Design: Input Interfacing-key switches, ADC, sensors etc. :output Interfacing- LED - 7 segment displays - LCD – relay interface –Stepper motor, programming and flowcharts (using assembly language)- case study- XY positioner with Potentiometer feedback.

Text Books:

1. Douglas V Hall, Microprocessors and Interfacing, Tata McGraw-Hill 2nd edition, 2008
2. Muhammad Ali Mazidi, The 8051 Microcontroller and embedded sytems, Pearson Education 2nd edition, 2006
3. Kenneth J. Ayala, The 8051 Microcontroller, Penram International, 3rd edition 2007

References:

1. Lyla B. Das, The x86 Microprocessors , Pearson Education, 2010
2. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Second Edition, 2008, Pearson Education

16-305-0201: INTRODUCTION TO EMBEDDED SYSTEMS

Course Description:

This course provides an introduction to Embedded Systems.

Course Objectives:

- Through the use of simulation software and practical sessions, real devices interfaced to a microcontroller and with embedded devices, the student will develop competence in microprocessor /microcontroller based digital system design and interfacing.
- Provides In-depth understanding of specialist bodies of knowledge within the engineering discipline.
- Fluent application of techniques, tools, design processes and resources.
- Design, test and critically evaluate embedded solutions to real world situations using digital component.
- Recognize the key features of embedded systems in terms of computer hardware and be able to discuss their functions. Students will be aware of the key factors affecting computing hardware evolution.

Course Contents:

Introduction to Embedded Systems: Overview of embedded systems, features, requirements and applications of embedded systems, recent trends in the embedded system design, introduction to RTOS, common architectures for the ES design, embedded software design issues, interfacing and communication Links, introduction to development and testing tools.

Embedded system controllers: RISC microcontroller (PIC16F88X), block diagram, pin details, on Chip features &Peripherals, addressing modes, instruction set, timers, counters, Hardware stack & stack operation, interrupt structure, instruction set, and capture/ compare/PWM Module, Power saving modes.

Interfacing: Interfacing standards, USART-RS232, RS 485, SPI, basic concepts of I^2C, USB, Analog interfacing and applications, ADC, LCDs, PC Keyboard, touch screen.

Embedded Software and Programming: Programming in embedded environment, embedded operating systems, Applications of Embedded Systems: Industrial and control applications, applications in the area of consumer appliances, Case study.

Introduction to ARM Processors: Popular ARM architectures, Registers, Current Program Status Register (CPSR), Processor modes, Register organization, Instruction set overview, Interrupts, ARM Cortex M3-LPC1343 programmer's model: Memory system, Data processing, processor and memory organization, data operations, flow of control, pipelining in ARM, ARM bus (AMBA), Designing with LPC1343.

References:

1. A. Silberschatz, P. B.Galvin and G. Gagne, Operating System Concepts (6th ed.), John Wiley & Sons, Inc., 2001 8. K.V.K.K. Prasad, Embedded/Real Time Systems: Concepts, Design and Programming, Dreamtech Press, New Delhi, India, 2003.
2. Douglas V. Hall, "Microprocessors and Interfacing Programming and Hardware", McGraw HillBook, Company, 1986
3. Microchip - Microcontroller application notes / data sheets.
4. Joseph Yiu, The Definitive Guide to the ARM Cortex-M3, Second Edition, Newnes, 2009, ISBN: 978-0-12-382090-7
5. LPC User Manual: www.nxp.com/documents/user_manual/UM10375.pdf
6. LPC Datasheet: www.nxp.com/documents/data_sheet/LPC1311_13_42_43.pdf
7. Daniel W. Lewis, Fundamentals of Embedded Software, where C and assembly meet, Pearson Education 2001.
8. John B. Peatman, Design with PIC Microcontrollers, Pearson Education, 1997.
9. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Elsevier Publication 2000.
10. Andrew N. Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide – Designing and Optimizing System Software, Elsevier Publications, 2007.

16-305-0203: CONTROL SYSTEMS

Course Description:

This course deals with analysis and modeling of continuous time and discrete time control systems

Course Objectives:

- To understand the basic need for block diagram and signal flow graph representation
- To have an idea about the concept of stability and various techniques for stability analysis
- To introduce the concept of state space modeling of systems

Course Contents:

General schematic diagram of control systems - open loop and closed loop systems – concept of feedback - modeling of continuous time systems – Review of Laplace transform - 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

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

Basic elements of a discrete time control system - sampling - sample and hold - Examples of sampled data systems – pulse transfer function - Review of Z-transforms - system function - mapping between s plane and z plane

Analysis of discrete time systems – 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

Introduction to the state variable concept - state space models - phase variable and diagonal forms from time domain - diagonalization - solution of state equations

Text Books:

1. Ogata K., "Modern Control Engineering", Prentice Hall India,1994
2. Ogata K., “Discrete Time Control Systems", Pearson Education, 2001

References:

1. Dorf R. C. & Bishop R. H., "Modern Control Systems", Nineth Edition, Addison Wesley,2001
2. Kuo B. C., "Digital Control Systems", Second Edition, Oxford University Press, 1992
3. Nagarath I. J. & Gopal M., “Control System Engineering”, Wiley Eastern Ltd.,1995
4. M. Gopal “Control system Principles and design” TMH, 1998

16-305-0205: DIGITAL SIGNAL PROCESSING

Course Description:

This course deals with analysis and design of various digital filters, various finite word length issues associated with DSPs and DSP processor architecture.

Course Objectives:

- To study the fundamentals of discrete-time system analysis
- To analyze and design digital FIR and IIR filters
- To have an overview of DSP architectures
- To study the finite word length effects in filter design

Course Contents:

Fourier analysis of discrete-time signals and systems: Discrete Fourier Series, Discrete Time Fourier Transform, Convolution; Linear and circular convolution, Practical implementation, Overlap-save and overlap-add methods.

Discrete Fourier Transform - Properties; Approximation of Fourier transform through DFT, Fast algorithms for DFT -The FFT algorithm – DIT & DIF algorithms, inverse DFT using FFT

Digital filters: FIR Filters: Impulse response, Transfer function, Linear phase properties, Design: window based design, frequency sampling design. IIR Filters: Impulse response, Transfer function, Pole-zero representation; Butterworth, Chebyshev, elliptic filter concepts

Approximation problem for IIR filter design: Impulse in variance method, bilinear transform method, matched z- transform method. Frequency transformations; Realization structures: Direct form 1 and 2, parallel and cascade

Digital Signal Processors: Introduction, TMS320C6x Architecture, Functional units, Linear and circular addressing modes, TMS320C6x instruction set, **Multi-rate signal processing**: Changing the sampling rate using discretetime processing – Sampling rate reduction by an integer factor – Compressor – Time andfrequency domain relations – Sampling rate increase by an integer factor – Expander – Timeand frequency domain relations – Changing the sampling rate by a rational factor

Text Books:

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications," Pearson Education, 4^{th} edition, 2007.
2. Rulph Chassaing, "Digital Signal Processing and Applications with theC6713 and C6416 DSK", John Wiley & Sons, Inc., 2005
3. Mitra S. K., "Digital Signal Processing: A Computer Based Approach," McGraw-Hill PublishingCompany, 1998.

References:

1. Oppenheim A. V., Schafer R. W., "Discrete-Time Signal Processing," Prentice Hall India, 1996.
2. Chi-Tsong Chen, "Digital Signal Processing: Spectral Computation and Filter Design," Oxford University Press, 2001.
3. Lonnie C. Ludeman, "Fundamentals of Digital Signal Processing," John Wiley& Sons, NY, 1986.
4. R. E. Bogner, A. G. Constantinidis, (Editors), "Introduction to Digital Filtering," John Wiley & Sons, NY, 1975.
5. Emmanuel C. Ifeacher, Barry W. Jervis, "Digital Signal Processing: A Practical Approach," 2nd edn., Pearson Education, 2004.
6. Boaz Porat, "A Course in Digital Signal Processing," Prentice Hall Inc, 1998.

16-305-0206 ROBOTICS TECHNOLOGY

Core/Elective: **Elective** Semester: 2, Credits: 3

Course Description:

This course provides an overview of Robot mechanisms, Kinematics, dynamics, programming, control and Basics of Mobile Robots. Topics include planar and spatial kinematics, and motion planning; mechanism design for manipulators and mobile robots, controller design, actuators and sensors; embedded controller design.

Course Objectives:

- To get an introduction about Robots and Robotics
- To understand the kinematics and dynamics of Industrial Robotics arms and mobile robots
- To get an introduction about various types sensors and actuators for Robots
- To understand the design of robot controllers and Programming of robotic systems

Course Contents:

Introduction: Definition, Robot Classifications – Cartesian, Cylindrical, Spherical Work Envelope, Types of joints, Prismatic, Revolute, Ball and socket, Number of Axes, Degree of freedom, Joint variables, Grippers - Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers .

Kinematics: World frame, joint frame, end-effectors frame, Rotation Matrix, composite rotation matrix, Homogeneous Matrix, Link Coordinate, Denavit-Hartenberg representation, Arm equation, Tool Configuration. Ref:1, Chapter 2.

Robot Dynamics: Velocity Kinematics, Jacobian, Singularities, Differencial motion, Euler – LaGrange Equation, Expression of Kinetic and Potential Energy, Equations of Motion. Ref:1, Chapter 3.

Sensors and Actuators: Potentiometric, Optical sensors - Optical Encoders, Absolute, Incremental, , Quadrature decoding Encoder Resolution. Direction of rotation, Velocity and acceleration measurements. Actuators-Hydraulic and Pneumatic, Electrical actuators: DC motors, AC motors, Stepper motors, BLDC, Solenoids. Motor drives:. PWM and H-bridges, case study L298 based drive.

Robot Programming & Robot Controllers: Teach-in, Teach-Through, High-Level languages –robot talk, Comparison of teaching and programming methods, Software speedup, Robot Controllers – essential components, joint actuation and Sensing, Overload, Over current and stall detection methods, Position, Speed and Direction Sensing.

References:

1. Fu K. S. ,et al "Robotics- Control, Sensing, Vision and Intelligence ", McGraw – Hill, 1987.
2. H. R. Everett, "Sensors for Mobile Robots – Theory and Applications", A. K. Peteres Ltd. 1995, ISBN 1-56881-048-2.
3. Roland Siegwart, Illah R, Nourbakhsh, "Introduction to Autonomous Mobile Robots", 2nd Edition, The MIT Press, 2011. ISBN 0-262-19502-X.
4. "Robotics and Automation Handbook", Edited:Thomas R. Kurfees,, CRC Press 2005.
5. Selig J. M., "Introductory Robotics",PHY(UK), 1992.
6. YoremKoren, "Robotics for Engineers", McGraw-Hill Book Co., 1992.
7. Groover M. P. et al., "Industrial Robotics – Technology, Programming & Applications", McGraw-Hill., 2005

16-305-0207: MICROWAVE INTEGRATED CIRCUITS

Course Description:

The technology of planar RF and microwave components and circuits are covered in this course.

Course Objectives:

- To understand the fundamentals of RF integrated circuits.
- To familiarize the design tools and the technology of MMIC fabrication

Course Contents:

Planar Transmission lines: , Strip line, Microstrip line, coplanar line, quasi – static models of microstrip line, effective permittivity, characteristic impedance, dielectric and conductor losses, substrates for MIC, slot line and coplanar waveguide.

Microstrip Passive Components: Discontinuities in Microstrip lines and coplanar lines, step, bent, T- junction, Hybrid line coupler, parallel coupled line and directional couplers, Even and odd mode analysis, Branch line couplers, impedance transformers.

Lumped Elements for MICs: Design and fabrication of lumped elements, circuits using lumped elements. Filters, Lumped constant Microstrip circuits

Nonreciprocal components for MICs: Microstrip on Ferromagnetic substrates, Microstrip circulators. Isolators and phase shifters. Design of microstrip circuits – high power and low power circuits.

MMIC Technology – Thick film and Thin film technology. Hybrid MIC's. Monolithic MIC technology, fabrication process, testing methods, encapsulation and mounting of devices.

Text Books:

1. Gupta K. C., and Amarjit Singh, Microwave Integrated circuits, Wiley Eastern,1974.
2. Bharathi Bhat and S. K. Koul, "Stripline-like transmission lines for microwave integrated circuits, New age international, 2007.

References:

1. T. C. Edwards ,"Foundation for Microstrip Circuit Design ," Jone Willy & sons. 2000

2. E. H. Fooks & R. A. Zakarevicuis,” Microwave Engineering using Microstrip Circuits.” Prentice Hall. Sakti 2000
3. Hoffman R. K., “Handbook of Microwave Integrated Circuits”, Artech House, Boston, 1987.

16-305-0208: COMPUTER ORGANISATION & ARCHITECTURE

Course Description:

Understand the basic concepts of Computer Architecture and Organization, and understand the key skills of constructing cost effective computer systems.

Course Objectives:

- To quantitatively evaluate the performance of different designs and organizations of computer
- To articulate design issues in the development of CPU especially Control Unit that satisfy design requirements.
- To understand the impact of instruction set architecture on cost performance of CPU Design.
- Understand memory hierarchy and its impact on computer performance/cost.
- Understand ways to take advantage of instruction level parallelism for high performance processor design.

Course Contents:

Introduction to Processor Architecture – Design Methodology- System Representation – Gate level – Register level – Processor level – CPU Organization – Data Representation – Basic Formats – Fixed Point Numbers – Floating Point Numbers – Instruction Sets – Instruction Formats – Instruction Types – Programming Considerations.

Datapath Design – Fixed Point Arithmetic – Addition and Subtraction – Multiplication – Division – Arithmetic Logic Units – Combinational ALUs – Sequential ALUs – Floating Point Arithmetic – Pipeline Processing

Control Design : Basic Concepts –Introduction – Hardwired Control – Design Examples – Microprogrammed Control – Basic Concepts – Multiplier Control Unit – CPU Control Unit – Pipeline Control – Instruction Pipelines – Pipeline Performance – Superscalar Processing

Memory Organization – Memory Hierarchy – Main memory – RAM and ROM chips – Memory Address Map – Memory Connection to CPU – Auxiliary Memory – Magnetic disks –

Magnetic Tape – Associative Memory – Hardware Organization - Read Operation – Write Operation – Cache Memory : Associative Mapping – Direct Mapping – Set Associative Mapping –Virtual Memory – Address Space and Memory Space. Storage devices: Hard Disks- Types and Classification based on interface, Optical Storage – CD, DVD, BLURAY.

System Organization – Communication Methods – Basic Concepts – Bus Control – I/O and System Control – I/O Organization – Isolated Versus Memory Mapped I/O - Programmed I/O – DMA and Interrupts – I/O Processors – Operating Systems – Parallel Processing – Processor Level Parallelism – Multiprocessors – Fault Tolerance.

References:

1. Patterson D.A. & Hennessy J.L., "Computer Organization and Design", Morgan Kaufmann Publishers, 2002
2. John P. Hayes "Computer Architecture and Organization", McGraw-Hill International Editions, Computer Science Series, 1998.
3. Morris Mano "Computer System Architecture", Prentice-Hall India, Eastern Economy Edition, 2009
4. Carl Hamacher, Zvonko Vranesic & SafwatZaky, "Computer Organization", Mc Graw Hill, 2001
5. Pal Choudhuri P., "Computer Organization and Design", Prentice-Hall India, 2nd Edition, 2003
6. William Stallings, "Computer Organization and Architecture", Pearson Education, 4th Edition, 2006

16-305-0209: WIRELESS COMMUNICATION

Course Description:

This course gives an overview of cellular communications. It provides details of the propagation mechanisms and difficulties faced in the channels during propagation. It gives an idea about the different multiple access techniques. The course also goes through the 4G systems and the latest wireless technologies.

Course Objectives:

- Idea about Cellular Communications
- Awareness about the challenges faced during transmission
- Understating different multiple access techniques
- Familiarizing 4G systems and latest wireless technologies

Course Contents:

Cellular Networks: Introduction – Concepts of cell- Frequency Reuse – Channel Assignment Strategies, Handoff strategies – Interference and System Capacity, Trunking and Grade of Service- Improving capacity- Cell splitting and Sectoring. GSM, CDMA UMTS, LTE standards and specifications

Propagation and Path Loss: Free space Propagation Model, Basic propagation mechanisms, Ground reflection Model, Knife-edge diffraction model, Radar cross section model. Path-loss Model: Log Distance Path-Loss Model.

Multipath and Fading: Small Scale Multipath propagation, Impulse response Model, Parameters of Multipath Channel, Types of Small scale fading: due to multipath time delay spread and Doppler spread.

Multiple Access Techniques: Introduction, FDMA, TDMA, Spread Spectrum Multiple Access: FHMA, CDMA, Hybrid Technique, SDMA. Packet Radio Protocols- Pure and Slotted ALOHA, CSMA. Capacity of CDMA networks.

Fourth Generation Systems and Wireless Technologies: Introduction – 4G Features and Challenges – Applications of 4G – 4G Technologies: MultiCarrier Modulation, Smart Antenna

Techniques, OFDM MIMO systems, Adaptive modulation and coding with time slot scheduler, BLAST system, Software Defined Radio, Cognitive Radio

Text Books:

1. Theodore S. Rappaport, "Wireless Communications: Principles & Practice", Second Edition, Prentice Hall of India Pvt. Ltd. (Low Priced Edition – Pearson Education Asia), 2002.
2. Vijay K. Garg, "Wireless Communications and Networking", First Edition, Morgan Kaufmann Publications, 2007

References:

1. William C.Y. Lee, "Mobile Communication Engineering: Theory & Applications", Second Edition, McGraw Hill, 1998.
2. Gordon L. Stuber, "Principles of Mobile Communications", Kluwer Academic Press,1996.
3. John G. Proakis, "Digital Communications", Fourth Edition, McGraw Hill, 2001.
4. Jochan Schiller, "Mobile communications", Addison-Wesley (Low Priced Edition – Pearson Education Asia), 2002.
5. Simon Haykin and Michael Moher, "Modern Wireless Communications", Pearson Education.
6. Andrea Goldsmith, "Wireless Communications", Cambridge University press.
7. A. J. Viterbi, "CDMA- Principles of Spread Spectrum",AddisonWesley, 1995.
8. Jerry R. Hampton, "Introduction to MIMO Communications", Cambridge University Press, 2014

16-305-0210: DATA STRUCTURES

Course Description:

This course is intended to understand the software aspects of the IT enabled world with case studies in C++

Course Objectives:

- Understanding the basic idea regarding the nature of problems and their solutions.
- Analyzing the various important components such as algorithms, complexity and specific solutions for modern IT problems.
- Learning the implementation of algorithms on a specific language platform.
- Motivating students towards understanding the complex nature of searching and identifying items in a very vast data set

Course Contents:

General concepts of object oriented programming: C++ Class overview-Class Definition. Access Control, Class Scope

Memory Allocation :Constructors and Destructors, Inheritance, Polymorphism, Overloading, Encapsulation, Friend functions, this pointer, dynamic memory allocation and de-allocation

Searching and Sorting - Searching: Linear and Binary search implementation, Hash Tables Sorting: Heap sort, Quick sort and Merge sort implementation

Linked lists - Stack and Queue, Binary tree - in-order, pre-order and post-order traversals - representation and evaluation of arithmetic expressions using binary tree - Binary Search trees - insertion, deletion and search- Linear time DFS and BFS implementation with adjacency list representation

Graph representation- Depth First Search (DFS), Breadth First Search(BFS), Minimum spanning tree problem - Kruskal's algorithm - implementation using disjoint set data structure- Prim's algorithm - Shortest path problem - Dijkstra's algorithms - implementation of Prim's and Dijkstra's algorithms using priority queue data structure

References:

1. Larry Nyhoff , ADTs, Data Structures and Problem Solving with C++, Second Edition, Pearson Education 2012
2. YedidyahLangsam, Moshe J Augenstein, Aaron M Tenenbaum, Data Structures Using C and C++ , Second Edition, PHI Publishers,1996
3. Sahni S., Data Structures, Algorithms and Applications in C++, Mc Graw Hill, Singapore, 1998.
4. T. H. Cormen, C. E. Lieserson, R. L. Rivest, C. Stein, Introduction to Algorithms (3/e), MIT Press, 2003
5. S. Dasgupta, C. H. Papadimitriou, U. Vazirani, Algorithms, McGraw Hill, 2006
6. A. V. Aho, J. D. Ullman and J. E. Hopcroft, Data Structures and Algorithms, Addison Wesley, 1983

18-305-0302: VLSI DESIGN

Course Description:

This course deals with the analysis & design of MOS circuits and the various design rules associated with CMOS design process

Course Objectives:

- To understand the basics of MOSFETs.
- To have a basic idea about CMOS fabrication technology.
- To introduce digital MOS circuit design principles.
- To familiarize students with the basic VLSI design flow.
- To introduce MOS scaling theory and expose them to the growing challenges in MOS IC design.

Course Contents:

MOSFET Device Physics: PN Junctions, Static and Dynamic Behavior, Secondary Effects, MOS Transistor, Ideal I-V Characteristics, C-V Characteristics, Non-Ideal I-V Effects.

CMOS Technology: Complementary MOS Logic - Inverter, Combinational Logic, NAND/NOR gates, Fabrication Process – n-well, p-well and twin tub process, wafer preparation, diffusion, ion implantation, oxidation, lithography, chemical vapor deposition, metalization, Latch-up in CMOS, Introduction to VLSI Design Flow.

Combinational Circuits: Static CMOS Circuits - CMOS Inverter, Static and Dynamic Behavior, Complementary CMOS design -Pull up and Pull Down Networks, Delay models, Logical Effort, Ratioed Logic, Pass-Transistor Logic, Transmission gates, Dynamic CMOS Circuits.
Sequential Circuits: Timing Metrics, Classification of Memory Elements, Static Latches and Registers, Dynamic Latches and Registers, Pipelining. **MOS Circuit Design:** MOS layers, stick diagrams – CMOS design style, stick diagram of inverter, 2-input NAND gate and 2-input NOR gate, Design rules and layout – layouts of 2-input NAND gate and 2-input NOR gate.

Delay, Power Dissipation and Scaling in MOS: Concept of sheet resistance and capacitances, Interconnect delay and modeling using Elmore delay, Power dissipation – Static and dynamic power dissipation, Scaling – scaling models and factors, constant field and voltage scaling, Limitations of scaling.

Text Books:

1. Neil H. E. Weste, David Harris, Ayan Banerjee, "CMOS VLSI Design, - A Circuits and Systems Percpective", 3rd edition, 2007.
2. D. S. Pucknell & K. Esharghian, Basic VLSI Design, Third Edition, Prentice Hall, 2000.

References:

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits – A Design Perspective", Pearson Education India, 2nd edition, 2016.
2. Donald A. Neamen & Dhrubes Biswas, "Semiconductor Physics and Devices", McGraw Hill Education, 4th edition, 2017.
3. S. Wolf, "Silicon Processing for VLSI Era", Lattice Press, 1990.
4. S. M. **Sze, "***VLSI Technology",* McGraw Hill Education, 2nd edition, 2017.
5. R. J. Baker, "CMOS Circuit Design, Layout and Simulation ", Wiley, 1st edition, 2009.

16-305-0303: COMMUNICATION SYSTEMS

Course Description:

This course is intended to understand the limitations of analog communications and to design and analyze various processing units of a digital communication system

Course Objectives:

- To have a basic idea about random process
- To analyze analog and digital modulation techniques for SNR calculation
- To evaluate digital communication systems under AWGN channel using the concept of signal space theory
- To familiarize the concept of estimation of signals using matched filter and correlation receivers

Course Contents:

Random processes: Introduction and specification, nth order joint distribution, mean and auto-correlation function, auto-covariance function, Cross-correlation and cross- covariance function. Stationary processes: Strict-sense stationarity, wide-sense stationarity (WSS), cyclo stationarity - auto-correlation function, cross-correlation function, and power spectral density of a WSS random process - Wiener-Khinchine theorem, low-pass and band- pass processes, power and banwidth calculations.

Analog Pulse Modulation: Sampling theorem for base-band and pass-band 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. Digital Pulse modulation: Quantization, PCM, DPCM, Delta modulation, Adaptive delta modulation

Signal space concepts: Geometric structure of the signal space, vector representation, distance, norm and inner product, orthogonality, Gram-Schmidt orthogonalization procedure. Matched filter receiver, Inter symbol interference, Pulse Shaping, Nyquist criterion for zero ISI, Signaling with duobinary pulses, Eye diagram, Equalizer, Scrambling and descrambling.

Review of Gaussian random process, Optimum threshold detection, Optimum Receiver for AWGN channel, Matched filter and Correlation receivers, Decision Procedure Maximum aposteriori probability detector- Maximum likelihood detector, Error probability performance of binary signaling. Digital band pass modulation schemes: ASK, FSK, PSK, MSK – Digital M-ary modulation schemes – signal space representation

Detection of signals in Gaussian noise - Coherent & non-coherent detection – Differential modulation schemes – Error performance of binary and M-ary modulation schemes – Probability of error of binary DPSK – Performance of M-ary signaling schemes in AWGN channels - Power spectra of digitally modulated signals, Performance comparison of digital modulation schemes.

References:

1. H. Stark, J. W. Woods, Probability and Random Processes with Applications to Signal Processing, Prentice-Hall, 2003.
2. Peyton Z. Peebles Jr., Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw-Hill, New Delhi,2002.
3. R.E. Ziemer and W. H. Tranter, Principles of Communications, JAICO Publishing House, 2001
4. B.P. Lathi, Modern Digital and Analog Communication, 3/e, Oxford University Press, 1998.
5. John G. Proakis and M. Salehi, Communication System Engineering, 2/e, Pearson Education, 2001

16-305-0305: ROBOTICS AND INTELLIGENT SYSTEMS

Core/Elective: **Elective** Semester: 3, Credits: 3

Course Description:

This course is aimed at learning basic and advanced techniques necessary for Robot motion planning, different Localization schemes, basics of Robot vision systems. Topics include Motion planning, Navigation techniques, Localization and mapping and robot vision. This course is supported by a Lab which includes: robot controller design and programming of robotic arm with the help of advanced embedded systems. Simulation experiments are also performed for supporting the theory course.

Course Objectives:

- To get an introduction about Mobile robots
- To understand the various Motion planning schemes in robotics
- To understand the various localization and Navigation methods
- To get an introduction about Robot/Machine Vision systems

Course Contents:

Mobile Robots: Introduction to Wheeled Robots, Classification of wheels, Fixed wheel, Centered Oriented Wheel, Off-centered oriented wheel, Swedish wheel, Mobile robot locomotion, Differential Wheel, Tricycle, Synchronous drive, Omni-directional, Ackerman Steering, Kinematics models of WMR.

Robot Motion Control: Robot Motion Planning, Path Planning, Geometric path, Obstacle avoidance, shortest path, Trajectory planning, The boundary conditions, Control Methods-Conventional Joint PID control, Computed torque, Nonlinear feedback, Adaptive Control, Variable Structure Control.

Motion planning and Navigation: Basics, Configuration Space, Obstrucles, Motion Planning Methods, Roadmap Approaches, Visibility graphs, Voronoi diagram, Cell Decomposition, Trapezoidal Decomposition, Potential Fields, Bug Algorithms, RRT.

Localization and Mapping: Introduction to localization – challenges in localization – localization and navigation, Mapping: map representation, Indoor and outdoor mapping, SLAM, Bayes rule, Passive and active Beacons sensors. Global Positioning System, DGPS, Laser Range Scanner

Robot Vision: Introduction, Image acquisition, Illumination Techniques, Image Conversion, Frame Buffers and Grabbers, Image sampling and Quantization, Basic Relationship between pixels, Image enhancement in Spatial and Frequency domain, Image Processing and Analysis Data Reduction: Edge detection, Feature Extraction and Object Recognition Algorithm and its applications.

Text Books:

1. Fu,K.S. ,et al "Robotics- Control, Sensing, Vision and Intelligence ", McGraw – Hill,1987.
2. H.R.Everett, "Sensors for Mobile Robots – Theory and Applications", A.K.Peteres Ltd. 1995. ISBN 1-56881-048-2.
3. Roland Siegwart, Illah R, Nourbakhsh, "Introduction to Autonomous Mobile Robots", The MIT Press, 2004. ISBN 0-262-19502-X.
4. "Robotics and Automation Handbook", Edited: Thomas R. Kurfees,, CRC Press 2005.

References:

1. "Where am I? Sensors and Methods for Mobile Robot Positioning", J. Borenstein, et al., The University of Michigan, 1996.
2. "Applying Machine Vision", Zuech, Nello, John Wiley and Sons, 1988.
3. "Robotics and Image Processing", Janakiraman P.A, Tata McGraw-Hill, 1995.

16-305-0307: RADAR AND SATELLITE COMMUNICATION

Course Description:

The fundamental aspects of RF communication systems, Radar and GPS systems is covered in this course

Course Objectives:

1. To understand the fundamentals of RF propagation and methods to improve its quality.
2. To familiarize different types of radars.
3. To understand the basics of satellite communication and GPS

Course Contents:

RF propagation: Loss in free space: Atmospheric effects on propagations and diffraction effects, Various Fadings, Path Analysis: Unfaded signal level, Thermal noise Threshold: Frequency deviation. Antenna gain, Noise on FM radio link: Sources of noise, FM improvement threshold, Noise power ratio

Radar Fundamentals: Introduction, Radar Equation, Block diagram, Radar frequencies, Applications, Pulsed Radar, Range ambiguities, Displays-Duplexers, Radar Cross Section

Radar Signal Characteristics: Radar pulse considerations, Minimum detectable signal, Receiver noise, Integration of radar pulses, FM-CW radar, MTI, pulse compression Radar.

Special purpose radars: Synthetic aperture radar, HF and over the horizon radar, Air surveillance radar, Height finder, Bistatic radar, Radar Beacons, Radar Jamming and Electronic Counter measures.

Satellite Communication: Communication Satellites, INS, Trilaiteration, Hyperbolic navigation, Transit, GPS; principle of operation, architecture, operating frequencies, orbits, Keplerian elements. Solar and Siderial days, GPS and UTC Time

Text Books:

1. Freeman, "Radio system Design for telecommunications", Wiley 1997

2. MerrilI Skolnik, Radar Handbook, McGraw Hill Publishers, 1990

References :

1. MerrilI Skolnik," Radar systems", McGraw Hill Publishers, 2005
2. B. Hofmann Wollenhof, H. Lichtenegger and J. Collins, "GPS Theory and Practice", Springer Wien, new York, 2000
3. J. C. Toomay, Paul Hannen "Radar Principles for the Non-Specialist", SolTech Pub. 2004

16-305-0309: EMBEDDED SOFTWARE AND REAL TIME SYSTEMS

Course Description:

This course provides an understanding to the students in the various aspects of embedded software and real time systems. It covers factors affecting embedded software along with methodologies in task scheduling, communication and resource management.

Course Objectives:

- Provide an understanding of the factors influencing embedded software.
- Study Resource and priority management issues faced in an embedded system
- Discuss the various scheduling algorithms in an embedded software
- Provide an understanding of Real Time Operating Systems
- Discuss the major task scheduling and communication algorithms
- Study the software development tools and standard programming techniques

Course Contents:

Factors influencing Embedded system design: CPU and memory types, Direct memory access, Interrupt basics, interrupt latency, disabling and masking interrupts, Shared data problems, atomicity, critical section.

Software Architectures for Embedded System: Round Robin approach, Round-Robin with interrupts, Real Time Operating Systems, soft and hard real time OS, tasks and task states, scheduler, reentrancy, semaphores, signaling, semaphore problems.

Tasks Scheduling: Interrupt driven systems, pre-emptive priority systems, hybrid systems, task control block model. Process scheduling, Fixed priority scheduling – Rate Monotonic approach, Dynamic priority Scheduling- Earliest Deadline First approach.

Communication and resource management: Message queue, mailbox, pipes. Inter-task communication, Blocking and non-blocking task synchronization. Nested interrupts, resource management, deadlock, starvation, pre-emption, priority inversion, priority inheritance, priority ceiling protocol.

Embedded software development tools: Host and target machines, cross compilers, Linker, locator, emulators, in-circuit emulators, monitors. The IEEE POSIX standard for programming, POSIX Threads, POSIX semaphores and shared memory.

Text Books;

1. An Embedded Software Primer - David E. Simon, Pearson Education.
2. Real- Time Systems Design and Analysis – Philip A. Laplante, Wiley & Sons.

References:

1. Embedded Systems - Raj Kamal, Tata McGraw Hill.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Shibu K V "Introduction to Embedded Systems", Tata McGraw Hill, 2010
4. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Elsevier 2000.

16-305-0311: COMPUTER NETWORKS

Course Description:

This course deals with the basic building blocks of a computer network and the architecture of the global Internet.

Course Objectives:

- Analysis of the protocols and algorithms to understand the basic principles on which they are designed
- Re-engineering various existing network technologies so as to enable design and development of more resource efficient and eco-friendly network technologies in the future
- Using the software tools available in the Internet to evaluate the performance of various protocols

Course Contents:

Introduction: Building blocks- links, nodes - Layering and protocols - OSI architecture - Internet architecture – Multiplexing -Circuit switching vs packet switching - Datagram Networks - Virtual Circuit networks.

Direct link Networks: Framing - Error detection - Reliable transmission - Multiple access protocols - Ethernet (IEEE 802.3) - Token Rings (IEEE 802.5) - wireless LAN (IEEE 802.11) - Bridges and LAN switches - ATM networks.

Internetworking: IPv4- addressing, datagram forwarding – ARP - Routing- distance vector (RIP) - Link state (OSPF) - routing for mobile hosts - Global Internet- subnetting– CIDR - inter-domain routing (BGP) - IPv6.

End to End protocols: Simple demultiplexer (UDP) - Reliable byte stream (TCP)- segment format, connection management, sliding window, flow control, adaptiveretransmission, congestion control, TCP extension, performance.

Broadband services and QoS issues: Quality of Service issues in networks- Integrated service architecture- Queuing Disciplines- Weighted Fair Queuing- Random Early Detection- Differentiated Services- Protocols for QOS support- Resource reservation- RSVP- Multi protocol Label switching- Real Time transport protocol, Cloud computing Basics**:** Cloud Computing Overview, Components, Infrastructure, Services, Applications, Storage, Database Services, Intranets and the Cloud.

Text Books:

1. Peterson L.L. & Davie B.S., "Computer Networks: A System Approach", Morgan Kaufman Publishers, 3rd edition, 2003.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach, McGraw Hill, 2010.

References:

1. James. F. Kurose and Keith.W. Ross, "Computer Networks, A top-down approach featuring theInternet", Addison Wesley, 3 edition, 2005.
2. D. Bertsekas and R. Gallager, "Data Networks", PHI, 2nd edition, 2000.
3. S. Keshav, "An Engineering Approach to Computer Networking", Pearson Education, 2005.
4. Gautam Shroff, Enterprise Cloud Computing Technology Architecture Applications, Cambridge University Press, 2010.

16-305-0313: ANTENNAS

Course Description:

Antenna is the essential component of communication systems. This course contains the basics principles as well as the description of modern types of antennas.

Course Objectives:

- To understand the fundamentals of RF propagation and methods to improve its quality.
- To familiarize different types of radars.
- To understand the basics of GPS

Course Contents:

Radiation of EM waves: Radiation mechanism, theories of radiation, antenna parameters, Schelkunoff's equivalence theorem, image theory, Polarisation, Friss transmission formula, Effective aperture, EIRP, short Antennas Antenna Measurements.

Antenna structures: Wire antennas and Aperture antennas, dipoles, loops, helical antenna, horns, lens and reflector antennas, log periodic antennas.

Antenna Arrays: Arrays of two isotropic point sources, Uniform N element array – Array factor – pattern multiplication, Linear arrays, Uniform and Non uniform amplitude distribution, Bionomial, Chebyshev and Taylor's distributions

Printed antennas: Rectangular and circular patch antenna design, Feeding techniques for micro strip antennas, Printed antenna arrays, Band width enhancement techniques.

Introduction to Smart Antennas – Spatial processing for wireless systems – Fixed beam forming networks – Switched beam systems – Adaptive Antenna Systems – Wide band Smart Antennas, Antenna synthesis Techniques,

Text Books:

1. Constantine Balanis A., Antenna Theory-Analysis and Design ,John wiley, 2005

2. Bahl I. J., and Bhartia, Microstrip Antennas, Artech House, 1982

References:

1. James J. R. Hall P. S. Wood C., Micro strip Antenna-Theory and Design, IET Electromagnetic Wave series, 1985
2. John D. Kraus, Ronald J. Marhefka, Ahmed S. Khan, Antennas and Wave Propagation, 4th Edition, McGraw hill Education, 2006

ANNEXURE

16-305-0107: MANAGEMENT FOR SCIENTISTS AND ENGINEERS (SMS)

Course Description:

The course is introduced as a part of CBCS scheme and will be handled by faculty in School of Management Studies.

Course Contents:

Introduction to Management: History of Management-Management Characteristics and Functions- Forecasting-Planning-Organizing-Staffing-Directing and Controlling-Traditional Management Versus Modern Management-Managerial Skills and qualities required for Scientists and Engineers-

Transition of an Engineer /Scientist to a Managerial Position

Managing Human Resource: Organizational Charts and Basic Relationships in Organizational Structures - Centralization and Decentralization of Organizations-Authority, Power, Responsibility- Span of Control- Delegation- Organization by Product-Function-Territory-Project and Matrix type. Recruitment and training. Performance Management: Basics of Goal setting and Performance measurement, feedback and improvement. Theories of Motivation- need hierarchy and Theory X theory Y. Working in teams- motivating and managing teams. Committees and Staff Meetings and their communications.

Managing Finance: Writing the cash book and bank book-preparing the income and expenditure statement. The budget-estimating inputs for the budget-preparing the budget-using it for control. Concept of time value of money and using Net Present Value (NPV) method in project appraisal for calculating Payback period. Basics of Costing- direct and indirect costs-overheads. Concept of Fixed, Variable cost, Contribution and calculating Break Even Point (BEP). Preparing Finance and cost projections for a Project Proposal. Concept of cash Flow. Reading Profit and Loss account and a Balance Sheet.

Managing the Project:

Project Characteristics-Linkage between Scope, Time and Cost and Work Breakdown structure (WBS)- estimating activity resources, time and costs-using CPM to do project scheduling and to find the critical path- concept of crashing. Monitoring Project progress, reporting and re-planning. Purchase cycle-intending-locating suppliers and getting quotations-evaluating quotations-issuing purchase orders- taxes involved- excise duty- customs duty-Sales Tax/ Service tax/VAT/GST and their payment. Receiving of goods, inspection- quantity-quality- specifications and performance-sampling- storage, issue and utilization. Store keeping essentials and maintaining the stock register. Rules for single machine scheduling.

Technology Management:

Product life cycle. Marketing and role of Engineers and Scientist in it. IPR and technology. Technology life cycle -innovation-invention-adoption-use-adaptation-diffusion--decline. Processes and challenges in taking technology from lab to pilot plant and to industrial scale. Managing R & D projects.

References:

1. Dhillon, B. S.(2002) Engineering and technology management tools and applications, Artech House technology management and professional development library, Boston, UK. ISBN 1-58053-265-9
2. GavrielSalvendy (Editor), (2002) Handbook of Industrial Engineering: Technology and Operations Management, 3 rdEdn, John Wiley & Sons, Inc.
3. Zandin, K J B (Editor), (2006) Maynards Industrial Engineering Handbook, Fifth Edn, McGraw Hill.
4. Chelsum, J.V, Payne, A C and Reavill L.I.P (2004), Management for Engineers, Scientists and Technologists, Second Edn, John Wiley and Sons Inc, ISBN 0-470- 02126-8
5. Babcock, D. L., (1996) Managing Engineering and Technology, Upper Saddle River, NJ: Prentice Hall.
6. Badaway, M. K.,(1995) Developing Managerial Skills in Engineers and Scientists,New York: Van Nostrand Reinhold.
7. Gaynor, G. H. (ed.), (1996), Handbook of Technology Management, New York: McGraw-Hill.

   Ullman, J. E. (ed.), (1986), Handbook of Engineering Management, New York: John Wiley and Sons.

16-305-0209/CAS2205 E2: NUMBER THEORY AND CRYPTOGRAPHY

Course Description:

The course is introduced as a part of CBCS scheme and will be handled by faculty in Department of Computer Applications

Course Contents:

Divisibility: ged, lem, prime numbers, fundamental theorem of arithmetic, perfect numbers, floor and ceiling functions. Congruence: properties, complete and reduced residue systems, Fermat's theorem. Euler function

Indeterminate equations: Linear and second degree Diophantine equations. Congruence in one unknown, Chinese remainder theorem, congruences of higher degree with prime and composite modulo, Wilson's theorem, quadratic residues.

Introduction to cryptography: attacks, services and mechanisms, security attacks, security services. Conventional Encryption – Classical techniques: model, stegnanography, classical encryption technique, Modern techniques: DES, cryptanalysis, block cipher principles and design.

Algorithms: triple DES, IDEA, blowfish. Confidentiality: Placement of encryption function, traffic confidentiality, key distribution, random number generation. Public key encryption – RSA algorithm, key management and exchange, elliptic curve cryptography.

Message Authentication: requirements, functions and codes, hash functions, security of hash functions and MACS. Hash algorithms: MD5 message digest algorithm, secure hash algorithm. Digital signature: authentication protocols, digital signature standard, Authentication Applications: Kerberos

Text Books:

1. Elementary Theory of Numbers – C.Y.Hsiung, Allied Publishers (World Scientific) New Delhi – 1992
2. Cryptography and Network Security Principles and Practice – W. Stallings Pearson Education Asia – 1999

References:

1. Introduction to Analytic number theory – Tom M. Apostol, Narosa Publishing House
2. An Introduction to the theory of Numbers – Niven & H.S. Zuckerman 3/e John Wiley & Sons, New York 1992.
3. The Mathematics of ciphers number theory and RSA cryptography – S.C.Coutinho- Universities Press (India) Pvt.Ltd. – 1999.
4. Applied Cryptography: Protocols, Algorithms & Source Code in C - B.Schnier 2/e John Wiley & Sons Ny.1996.
5. Neal Kohlitz – A course in Number Theory and Cryptography – Springer
6. An Introduction to cryptography – Johannes A.Buchmann
7. Methods in Number theory- Melvyn B.Nuthanson .Sp.2005.

16-305-0210/CAS2205 E3: APPLIED PROBABILITY & STATISTICS

Course Description:

The course is introduced as a part of CBCS scheme and will be handled by faculty in Department of Computer Applications

Course Contents:

Basic Statistics: Collection, tabulation and presentation of data, measure of central tendency, dispersion, correlation, association and grouping of data.

Probability: Sample space and events, Axioms of Probability, Additive theorem, Independence and Multiplicative theorem, Conditional Probability and Baye's theorem, Random experiments, Discrete and continuous random variables, Distribution function, Mean, Variance and moment generating function. Probability Distributions: Genesis and basic properties of Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

Sampling Distributions: Population and Samples, Simple random sampling with and without replacement. Sampling distribution of sample mean when variance is known and unknown, Chi-Square-, Student's-t- and F- distributions. Estimation: Properties of estimates, Methods of estimation – method of maximum likelihood, method of moments and method of least squares. Illustration for each case.

Interval estimation: Confidence interval for the mean of normal distribution when the variance is known and unknown, Two-sample confidence interval for normal population, Confidence interval for the proportions. Testing of Hypothesis: Simple and composite hypotheses, Type I and Type II errors, power of a test, Tests of hypotheses on single sample, two-sample, proportions, Chi-square test of goodness of fit and independence.

Regression Analysis: Simple linear regression, estimation of parameters in a linear regression model, measuring the adequacy of the regression model, One-way analysis of variance.

Text Books:

1. Hines, W.W, Montgomery, D.C, Goldman, D. M. and Borror, C.M, 'Probability and Statistics in Engineering'. 4/e. 2003, John Wiley & Sons.
2. Walpole, R. E., Myers, R. H., Myers S L & Keying Ye, 'Probability and Statistics for Engineers and Scientists'. 8/e, 2007, Pearson Education

References:

1. Gupta S. C. and Kapur V. K., "Fundamentals of Mathematical Statistics", Sultan Chand and Co.
2. Erwin Miller and John E.Freund, "Probability and statistics for engineers", Prentice-Hall of India / Pearson, 7th Ed.

16-305-0211/CAS2202: OBJECTED ORIENTED PROGRAMMING WITH C++

Course Description:

The course is introduced as a part of CBCS scheme and will be handled by faculty in Department of Computer Applications

Course Contents:

Introduction to object oriented paradigm, Basic concepts of object oriented programming, Applications of OOP. Introduction to C++ - I/O Streams, Datatypes and declarations, Operators, Arrays, Strings, Control flow, Storage classes and linking, File streams, Pointers, Reference variables, Functions, Inline functions, Default arguments, Function Overloading.
Classes and objects, Static members and functions, Const objects and Const member Functions, Friend functions, Object initialization and cleanup-Constructors, Different types of constructors, Destructors, Container classes.
Dynamic Object creation-new and delete Operators, this pointer, Operator overloading. Inheritance - Different types of inheritance, Abstract classes, Inheritance versus Composition. Polymorphism and virtual functions, Pure virtual functions, Abstract classes, Dynamic binding, Casting, Object slicing.
Templates- Function Templates, Class templates, Overloading of templates, Exception handling, Namespace.

Text Book:

1. Mastering C++, Venugopal, 1999 Edition, Tata Mc Graw Hill

References:

1. Bjarne Stroustrup, “The C++ programming language”, 2000 Edition, Pearson
2. Herbert Scheldt, “The Complete Reference C++”, 2003 Edition, Tata Mc Graw Hill
3. Robert Lafore , “Object Oriented Programming in C++”, 2000 Edition

16-305-0212/MAM 2447 CODING THEORY AND CRYPTOGRAPHY

Course Description:

The course is introduced as a part of CBCS scheme and will be handled by faculty in Department of Mathematics

Course Contents:

Introduction to Coding Theory, Weight and distance, Maximum likelihood decoding, Linear codes, Matrices, Bases for C and C+ (Chapters 1.1 – 1.12, 2.1 – 2.5)

Generating matrices, parity check matrices, cosets, MLD for linear codes, perfect codes, Hamming Codes, Extended Codes (Chapters 2.6 – 2.11, 3.1 – 3.4)

Cyclic linear codes, polynomial encoding and decoding, dual cyclic codes, finite fields, cyclic Humming Codes, BCH codes (Chapters 4 & 5)

Classical cryptography, Encryption schemes, Symmetric key encryption, Fiestel ciphers, DES (Chapter 10.1, 10.2, 10.3)

Public key cryptography, One-way and has functions, RSA El-gamal, Cryptographic protocols (Chapter 12.1 – 12.5)

Text Book:

1. Coding Theory and Cryptography – Essentials II Ed. Dr. Hankerson etal.Dekker (2000)

References:

1. Vera Pless, Theory of Error correcting codes II Ed.
2. Stinson D.R. Cryptography – Theory and Practice, CRC (2002)

16-305-0309/CAS2502 E23: ARTIFICIAL INTELLIGENCE

Course Description:

The course is introduced as a part of CBCS scheme and will be handled by faculty in Department of Computer Applications

Course Contents:

What is AI, History of AI,Intelligent Agents – Agents and environments – Good behavior – The nature of environments – Structure of agents – Problem Solving –Problem solving agents – Example problems – Searching for solutions – Uniformed search strategies – Avoiding repeated states – Searching with partial information.

Informed Search Strategies – Heuristic function – Local search algorithms and optimisation problems – Local search in continuous spaces – Online search agents and unknown environments – Constraint satisfaction problems (CSP) – Backtracking search and Local search – Structure of problems – Adversarial Search – Games – Optimal decisions in games – Alpha – Beta Pruning – imperfect real-time decision – Games that include an element of chance.

Logical Agents, Reasoning pattern in propositional logic,Effective propositional inference, Agents based on Propositional Logic First Order Logic – syntax and semantics – Using first order logic –Knowledge engineering Inference – Prepositional versus first order logic – Unification and lifting – Forward chaining – Backward chaining –Resolution

Knowledge representation – Ontological Engineering –Categories and objects – Actions – Simulation and events – Mental events and mental objects. Planning: The planning problem – Planning with state space search – Partial order planning Planning graphs – Planning with propositional logic

Learning From Observations – forms of learning – Inductive learning -Learning decision trees – Ensemble learning

Text Book:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", Second Edition, Pearson Education, 2004.

References:

1. Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd., 2000.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Third Edition , Tata McGraw Hill, 2009.

16-305-0310/ MAM 2436: WAVELETS

Course Description:

The course is introduced as a part of CBCS scheme and will be handled by faculty in Department of Mathematics

Course Contents:

Construction of Wavelets on Z_N the first stage, the Iteration step

Examples and Applications

$l^2(Z)$, Complete orthonormal sets in Hilbert spaces $l^2(\ )$ and Fourier series. The Fourier Transforms and convolution on $l^2(Z)$

First stage wavelets on Z.The iteration step for wavelets on Z. Implementation and Examples

$l^2(R)$ and Approximate Identities. The Fourier transform on R

Text Book:

1. Frazier M.W. – An Introduction to wavelets through Linear Algebra – Springer (1999) (Chapters 3 and 4 and sections 5.1 and 5.2 of Chapter 5)

References:

1. Charles K Chui - An Introduction to Wavelets, Academic 1992.
2. Daubechies – Ten lectures on Wavelets SIAM, 1992
3. K.R. Unni – Wavelets, Frames and Wavelets Bases in LP lecture Notes (1997, Bhopal)

16-305-0311/ CAS2504 E32: ARTIFICIAL NEURAL NETWORKS

Course Description:

The course is introduced as a part of CBCS scheme and will be handled by faculty in Department of Computer Applications

Course Contents:

Basic concepts-single layer perceptron-Multi layer perceptron-Adaline-Madaline- Learning rules-Supervised learning-Back propagation networks-Training algorithm, advanced algorithms-Adaptive network- Radial basis network modular network-Applications

Introduction- unsupervised learning -Competitive learning networks-Kohonen self organising networks-Learning vector quantisation - Hebbian learning – Hopfield network-Content addressable nature, Binary Hopfield network, Continuous Hopfield network Travelling Salesperson problem - Adaptive resonance theory –Bidirectional Associative Memory-Principle component Analysis

Introduction – crisp sets an overview – the notion of fuzzy sets – Basic concepts of fuzzy sets – classical logic an overview – Fuzzy logic. Operations on fuzzy sets - fuzzy complement – fuzzy union – fuzzy intersection – combinations of operations – general aggregation operations

Crisp and fuzzy relations – binary relations – binary relations on a single set– equivalence and similarity relations – Compatibility or tolerance relations– orderings – Membership functions – methods of generation – defuzzification methods

Adaptive Neuro Fuzzy based inference systems – classification and regression trees: decision tress, Cart algorithm – Data clustering algorithms: K means clustering, Fuzzy C means clustering, Mountain clustering, Subtractive clustering – rule base structure identification – Neuro fuzzy control: Feedback Control Systems, Expert Control, Inverse Learning, Specialized Learning, Back propagation through Real –Time Recurrent Learning.

References:

1. Fuzzy Logic Engineering Applications", Timothy J. Ross, Mc GrawHill, NewYork, 2009.
2. "Fundamentals of Neural Networks", LaureneFauseett, 3rd Ed, Prentice Hall India, New Delhi, 2008.
3. "Neuro Fuzzy and Soft computing", Jang J.S.R., Sun C.T and Mizutani E – Pearson education, 2004
4. "Neural networks, Fuzzy logics and Genetic algorithms", S. Rajasekaran and G.A. VijayalakshmiPai, Prentice Hall of India,2003
5. Fuzzy Sets and Fuzzy Logic", George J. Klir and Bo Yuan, Prentice Hall Inc., New Jersey,1995

16-305-0312/MAM 2330/2430: INTEGRAL TRANSFORMS

Course Description:

The course is introduced as a part of CBCS scheme and will be handled by faculty in Department of Mathematics

Course Contents:

Integral Transforms, The Fourier Integral Formulas, Fourier Transforms of generalised functions, Basic Properties of Fourier Transforms, Z-transforms.

Poisson's Summation formula, The Shannon Sampling Theorem, Gibbs Phenomenon, Heisenbergs' Uncertainty Principle, Applications of Fourier Transform to ODE, Laplace Transforms and their basic properties.

Convolution Theorem and the properties of convolution, Differentiation and Integration of Laplace transforms, The Inverse Laplace Transforms, Tauberian theorems and Watson's Lemma, Applications of Laplace transforms, Evaluation of Definite Integrals, Applications of Joint Laplace and Fourier Transform.

Finite Fourier Sine and Cosine transforms, Basic properties and Applications, Finite Lapace Transforms, Tauberian Theorems.

Hilbert Transform and its basic properties, Hilbert transform in the complex plane, applications of Hilbert Transform, Asymptotic expansion of One sided Hilbert Transform.

Text Books:

LoknathDebnath, Dambaru Bhatta Integral Transforms and their Applications, second edition, Taylor and Francis, (2007).

References:

1. Frederick W. King, Hilbert Transforms, CRC (2009).
2. Larry C. Andrews, Bhimsen K. Shivmaoggi Integral Transforms for Engineers, (1999).
3. Ian N. Sneddon, The Fourier Transforms, Dover Publishers (1995).
4. Joel L.Schi , Laplace Transforms: Theory and Applications, second revised edition, Springer (1980).
5. B.Davies, The Integral Transforms and their applications, Springer-Verlag (1978).
6. Ian N. Sneddon, The Use of Integral Transforms, McGraw-Hill (1972).