FIRST YEAR M.Sc.
ELECTRONIC SCIENCE

SEMESTER - I

Academic Year 2022-2023

M.Sc. Electronic Science - Course structure & Credits Distribution

Semester	Course Code	Course Title	No. of credits
Sem-I	PSEL111	**Mathematical Methods in Electronics and Network Analysis**	04
	PSEL112	**Integrated Circuit Analysis**	04
	PSEL113	**Digital System Design using Verilog**	04
	PSEL114	**Advanced 'C' & JAVA Programming.**	04
	PSEL115	**Electronics Science Practical Course I**	04
	PSEL116	**Electronics Science Practical Course II**	04

Faculty of Science
Post Graduate Extra Credits

Semester	Course Code	Title of the Course	No. of Credits
I		Human Rights - I	2
		Introduction to Cyber Security - I	2

PSEL111: Mathematical Methods in Electronics and Network Analysis [Credit-4]

Objectives:

1. To learn the methods of analysis for CT and DT signals and systems
2. To learn concept of mathematical modeling of simple electrical circuits
3. To get familiar with role of differential equations in applied electronics
4. To know about mathematical tools and techniques for network analysis

Unit-1: Mathematical Modeling, Electronic Signals & System (15L)

Concept of modeling, types, mathematical modeling using differential equations, Differential Equation, Ordinary Differential Equations (ODE), DE and their occurrences in real life problems, linear differential equation with constant coefficients, partial DE

Signals: periodic, aperiodic, Continuous Time (CT) and Discrete Time (DT), Basic Operations on Signals, signal types, amplitude and phase spectrum, special electronic signals (impulse, unit step, sinusoidal, ramp, square wave, staircase), Classification of Systems, Representations of Systems.

Unit-2: Mathematical Tools for Circuit Analysis (20L)

Laplace Transform (LT): definition, LT of standard electronic signals, inverse LT, methods of ILT (partial fraction method), properties of LT (shifting, linear, scaling), initial and final value theorem, LT of derivatives and Integrals, solution of DE using LT, concept of Transient and steady state response, Laplace transformation of electrical circuits, Network Transfer function.
Z-Transform (ZT): definition, ZT of standard electronic signals, properties of Z transform, inverse ZT (partial fraction and residue method), linear difference equation and solutions using ZT.
Concept of transfer function of CT and DT systems, time and frequency domain response of systems using transfer function, poles and zeros of transfer function and their significance, applications to simple passive filters such as Low Pass (LP), High Pass (HP), Butterworth filters, synthesis of transfer function using poles and zeros, stability criterion, Routh-Hurwitz criterion.

Unit-3: Network Analysis (15L)

Two port network functions, Network Topology (nodes, tree, graph, branch, mesh, and loop), Mesh, loop and nodal analysis of circuits, T and π networks, state variable method with simple examples Network Theorems and Applications to DC and AC Circuits: Thevenin's, Norton's, superposition, maximum power transfer – theorems.

Unit 4:Signal and System Analysis using MATLAB (10L)

MATLAB environment: Basic Structure of Matlab, File types, Matlab commands and operators, tool boxes, Arithmetic and Logical operations. Creating simple plots, MATLAB scripts and functions (m-files), Control structures (if, if-else, else-if, switch, for, while etc).

Text / Reference Books:

1. Advanced Engineering Mathematics, E. Kreyzig, John Wiley andSons.
2. Signals and system by P Ramesh Babu and Anandanatarajan, Scitech
3. Network Analysis, G. K. Mittal, KhannaPublication.
4. CircuitsandNetworksAnalysisandSynthesis,A.Sudhakar,ShyamMohanand S. Pilli,TMH.
5. Digital Signal Processing, S. Salivahan, A. Vallavraj and C. Gnanpriya, McGraw Hill.
6. Network Analysis, M. E. Van Valkenberg,PHI.
7. Network and Systems, Roy Choudhary, WileyEastern.
8. Microwave Devices and Circuits, Samuel Y. Liao, 3rd Edition, PHI,2002.
9. Basics of MATLAB and Beyond by Andrew Knight, CRC

PSEL112: Integrated Circuit Analysis
[Credit 04]

Objectives:

1. To deliver the knowledge about physics of basic semiconductor devices and circuits.
2. To learn the characteristics and working of electronic devices
3. To study the various device models
4. To study the wideband and narrowband amplifiers using BJT
5. To develop skills in analysis and design of analog circuits
6. To study the designs of opamp applications

Unit-1: Basic Semiconductor Devices (15L)

Diode and applications- Practical diode characteristics (static and dynamic resistance), temperature effects, switching characteristics, diode breakdown, diode applications in wave shaping circuits.
BJT- construction and biasing, Operation, CC, CB and CB configurations JFET- construction, types and its operation, parameters, characteristics, JFET amplifiers.
MOSFET- types, biasing of MOSFET, applications, comparison between BJT, JFET, MOSFET.

Unit-2: Analysis of Amplifiers (15L)

BJT models and modeling parameters -equivalent circuits for CE, CB and CC configurations, single stage amplifier, class A and class B, class C, class AB amplifier, small signal analysis, distortion.
Design of single stage RC-coupled amplifier with frequency response (f1 and f2), bode plots, frequency response of multistage amplifiers, different coupling schemes, gain of multistage amplifiers.

Unit-3: Tuned Amplifier and Oscillators (10L)

Tuned amplifier -design, multistage tuned amplifiers: synchronous and stagger tuning cascade configuration, large signal tuned amplifier .
Oscillators- design and analysis of LC and RC oscillators, Hartley, Colpitt's, Miller oscillators, phase shift and Wien-bridge oscillators, crystal oscillators and applications **.**
Data converters:- 1)ADC – types , characteristic **2)**DAC- types , characteristic.

Unit-4: Operational Amplifiers and their Applications (20L)

Opamp - Practical consideration in opamp based circuit design
Opamp parameters- dc and low frequency parameters and their significance in design of opamp, closed loop stability analysis and frequency compensation.
Opamp application- Inverting and non-inverting amplifiers with design aspects such as input and output impedance, common mode errors and limitations, bandwidth, etc. Bridge and instrumentation amplifier Practical design aspect of integrator and differentiators, such as offset error and stability, bandwidth considerations. Concept and applications of PLL.
Active Filters: transfer functions poles and zeros, Design of active filters - LPF, HPF, BPF and BRF (first and higher orders), Butterworth and Chebyshev filters.

Text / Reference Books:

1. Electronic Devices and Circuits, S. Salivahanan, N. Suresh Kumar, 3rd Edn, McGraw Hill.
2. Electronic Devices and Circuit Theory, Robert Boylestead, Louis Nashelsky, PHI.
3. Electronic Devices & Circuits: Milliman and Halki
4. Design with Operational Amplifiers and Linear IC, Sergio Franco, 3rd Edn, TMH.
5. Electronic Principles, Malvino and Bates, McGraw Hill.
6. Operational amplifier, G.B.Clayton, Elsevier Sci. Tech.
7. Microelectronic Circuits: Analysis and Design, Mohammad H. Rashid, PWS Publishing
8. Digital Switching Circuits, Millman Taub, TMH.
9. Electronic devices, Allen Motershed, PHI.
10. Integrated electronics, Millman Halkies, McGraw Hill.

PSEL113 : Digital System Design using Verilog

[Credit-4]

Objectives:

1. To understand sequential and combinational logic design techniques
2. To introduce VERILOG
3. To learn various digital circuits using VERILOG
4. To learn Programable Devices and their applications

Unit-1: HDL for Digital System Design **10L**

VERILOG: design flow, EDA tools, data types, modules and ports, operators, gate level modeling, data flow modeling , behavioral modeling, tasks and functions, timing and delays, test bench, types of test bench, comparison between VERILOG and VHDL language.

Unit-2: Combinational Logic **15L**

Introduction to combinational circuits, realization of basic combinational functions-magnitude comparator, code converters, multiplexers, demultiplexers, multiplexed display, encoder and decoders, priority encoders, parity generator/checker, arithmetic circuits (adder, Subtractor, binary multiplier), parallel adder, look ahead carry generator, VERILOG models and simulation of above combinational circuits.

Unit-3: Sequential Logic Design and Circuits **20L**

Introduction to sequential circuits, Flip flops: types, state table, transition table, excitation tables, timing waveforms, clock generators.

Counters: synchronous, asynchronous, design of counters, up/down counter.

Shift Registers: ring counter, Johnson counter.

Finite State Machine (FSM) Design: Mealy and Moore state machines.

VERILOG Models and Simulation Code of above Sequential Circuits and FSMs: stepper motor controller, traffic light control, washing machine control, parking controller, coffee vending machine, LCD controller.

Unit-4: PLDs and Memories **15L**

Need of PLD, architecture of simple PLD (SPLD)-PAL, PLA, ComplexProgrammable Logic Device (CPLD) and Field Programmable Logic Devices (FPGA), CPLD/FPGA based system design applications - typical combinational and sequential systemimplementation, estimation of uses of blocks, links, LUTs, etc.

Memories: types, data storage principle, control inputs, and timings, applications, Random Access Memories (RAM), Static Ram (SRAM), standard architecture, transistor cell diagram, sense amplifier, address decoders, timings, Dynamic RAM (DRAM), different DRAM cells, refresh circuits, timings, role of memories in PLD.

Text / Reference Books:

1. Verilog HDL; A Guide to Digital Design and Synthesis, Samir Palnitkar, Pearson Education,
2. Verilog HDL synthesis; A Practical Primer, J. Bhaskar, Star Galaxy Publishing, 1998.
3. Digital System Design with VERILOG Design, Stephen Brown, Zvonko Vranesic, TMH, 2nd Edn,
4. Digital design; Principles Practices, Wakerly, PHI.
5. Modern Digital Electronics, R.P Jain, McGraw Hill.
6. Digital systems; Principles and Applications, Tocci, Pearson Education.
7. Digital Logic and Computer Design, Morris Mano, PHI.

PSEL114: Advanced 'C' & JAVA Programming.
Credit-(04)

Objectives:

1. To understand basic concepts of C programming language.
2. To learn various advanced features, graphics and interfacing.
3. To learn concepts of object oriented programming in JAVA.

Unit-1: Introduction to C **15L**

C fundamentals: Introduction of high-level programming language, operators and it's precedence, various data types in C, storage classes in C. Control statements: Decision–making and forming loop in programs.Arrays & pointers: handling character, arrays in C, pointers in C, advanced pointers, structure and union.Functions: user defined function, pointer to functions.

Unit-2: Advanced Features and Interfacing **15L**

Miscellaneous and advanced features: command line argument, dynamic memory. Allocation, Data files in C, file handling in C, C Programming examples.

Interfacing: interfacing to external hardware, via serial/parallel port using C, parallel port functions, interfacing with LED and seven segment display, applying C to electronic circuit problems.

Unit-3: Graphics in C **15L**

Graphics in C: graphics-video modes, video adapters, C Graphics functions, arc bar circle, bar3D, rectangle, ellipse, drawpoly, fillellipse, fillpoly, Getbkcolor etc. drawing various objects and electronic components on Screen.

Unit-4 Introduction to JAVA **15L**

Introduction to object oriented programming, objects, Classes, inheritance, polymorphism, overloading. Operators, Input in JAVA, mathematical library methods, Conditional and Iterative constructs, Programming examples

Text / Reference Books:

1. Computer programming in C, V. Rajaraman, Pearson Education, 2nd edition,2003.
2. The C programming language, Dennis Ritchie, Pearson Education, 2nd edition,2003.
3. Graphics programming in C, Roger T. Stevens, BPB Publications.
4. Java: A Beginner's Guide, Eighth Edition ,Herbert Schildt, McGraw-Hill Education.
5. **Java - The Complete Reference**, Herbert Schildt 11th Edition, McGraw Hill Education
6. Programming in C, Stephen G. Kochan. CBS.

PSEL115: Electronic Science Practical Course - I

[Credit-4]

Group A: Analog Circuit Design = 7

Group B: Digital Electronics = 3

Group C: Activity = 2

[A] Practical based on Circuit Design

1. Bootstrap ramp generator for delay triggering
2. Tuned amplifier small signal / large signal for IF
3. Voltage controlled current source / sink and current mirror and doubler
4. Comparator and Schmitt trigger with single supply operation
5. Second order Butterworth filters (BP and BR)
6. Waveform generation: Quadrature Oscillator, Bubba Oscillator
7. V to F and F to V using commercially available IC
8. Instrumentation amplifier for a given gain
9. Low current negative power supply using IC555 / dual power supply using single battery
10. PLL characteristics and demonstrate any one application (IC565/CD4046)
11. Design RC phase shift oscillator using op-amp for frequency _____
12. Design Wien-bridge oscillators using op-amp for frequency _____
13. To design and set up an integrator and differentiator circuit using op-amp
14. Analog to Digital Convertor.

[B] Practical based on Digital Design

1. Two digit combinational lock
2. Keyboard encoder with latches
3. Traffic light controller
4. Multiplexed display (Bank token / two digit counter)
5. Bidirectional stepper motor control (Sequence Generator)
6. One digit BCD adder and 8-bit adder / subtractor
7. Object counter (use of MMV, counter)
8. Binary-Gray and Gray-Binary code converter
9. Design a mod-- synchronous counter using JK flip flop.
10. Design full adder using MUX

[C] Activity: Equivalent to TWO Experiments

PSEL116: Electronic Science Practical Course - II

[Credit-4]

Group A: Verilog programming, CPLD/FPGA = 6

Group B: Mathematical Methods for Electronics (C/MATLAB/PSPICE) = 4

Group C: Activity = 2

[A] Practical Based on VERILOG Programming and Implementation on CPLD/ FPGA

1. Combinational Logic
    a. Parity Generator and checker
    b. Hamming Code Generator
    c. Manchester code Generator
2. Sequential Logic
    a. Up-down bit binary counter (minimum 4-bit)
    b. Universal shift register
3. Four bit ALU design (structural modelling)
4. Keyboard Scanning
5. Designing of Traffic light Controller
6. Implementation of 8 bit multiplexer
7. LCD controller
8. Code Converter (BCD to seven Segments)
9. State machine (Stepper sequence generator/Vending Machine/ Washing Machine)
10. Barrel shifter

[B] Practical based on C / MATLAB / PSPICE

1. Phase and frequency response of a CT system: Low Pass and High Pass
2. Phase and frequency response of a DT system: Low Pass and High Pass
3. Transient and steady state response of CT system: LCR series circuit
4. Simulation of transfer function using poles and zeros
5. Synthesis of periodic waveform from Fourier coefficients
6. Solution of differential equation with given boundary conditions
7. Analysis of a given dc electrical circuit
8. Effect of locations of poles and zeros on the transfer function and corresponding frequency response
9. Laplace transform of given function ……

[C] Activity: Equivalent to TWO Experiments

OR

Circuit Simulation Using Software