Syllabus: 4-Semester M.Sc. in Electronics

(Effective from 2015 Entry Batch)

West Bengal State University

Barasat, Kolkata 700 126

Objective of the Programme

M.Sc. Electronic Science is a postgraduate electronics course. Electronics is a field of science and technology that studies the controlled movement of electrons through various media and vacuum. The objective of this course is to equip the students with the required knowledge and practical training to make them proficient at technologies and trains them to take up projects relevant to the industrial needs, the R& D activities and self-employment opportunities.

After completion of this course, the students can study further to enhance their qualification. If the student holds an interest in research then they may pursue Ph.D and Post-Doctoral research.

There are several Career opportunities for the students such as Indian Telephone Industries, NPL, A.I.R, Posts and Telegraph Department, Telecommunication, Defence, Railways, Bharat Electronics Limited, D.R.D.O, ISRO, Television Industry and Research & Development, Software Engineering/IT, Hardware Manufacturing with a good salary.

Grand Total Marks: 1200 (80 Credits). Theory: 800 (60 Credits), Practical: 400 (20 Credits).

Semester I

Paper Title	Paper Code	Full Marks	Credits
Analog Circuits and Systems	ELTC 222 111	50	4
Semiconductor Devices and Materials	ELTC 222 112	50	4
Mathematical Methods in Electronics	ELTC 222 113	50	4
Lab 1: Analog Circuits and Devices	ELTC 222 114	100	5
Total		250	17

Semester II

Paper Title	Paper Code	Full Marks	Credits
Digital Circuits	ELTC 222 121	50	4
Network Analysis and Synthesis	ELTC 222 122	50	4
Signal and Control Systems	ELTC 222 123	50	4
Programming Language C/C++	ELTC 222 124	50	4
Lab 2: Digital Circuits and Fault Diagnosis	ELTC 222 125	100	5
Total		300	21

Semester III

Paper Title	Paper Code	Full Marks	Credits
Electromagnetic Field and Radiation	ELTC 222 211	50	4
Electronic Communication Systems	ELTC 222 212	50	4
Quantum and Optoelectronics	ELTC 222 213	50	4
Digital Signal Processing	ELTC 222 214	50	4
Lab 3: Electronic, Fiber Optic and Microwave Communication	ELTC 222 215	100	5
Total		300	21

Semester IV

Paper Title	Paper Code	Full Marks	Credits
Instrumentation	ELTC 222 221	50	4
Microprocessor and Microcontroller	ELTC 222 222	50	4
VLSI and Power Electronics	ELTC 222 223	50	4
Lab 4: Microprocessor and Microcontroller	ELTC 222 224	100	5
Project	ELTC 222 225	100	4
Seminar (if project is not offered)	ELTE 222 225	50	2
Grand Viva (if project not offered)	ELTE 222 226	50	2
Total		350	21

Semester – I

Semester – I: ELTC 222 111: Analog Circuits and Systems

Course Outcome:

Students after successfully completion of the course will be able to:

- Impart knowledge on analog circuits
- Impart knowledge on circuit operation and functionality
- Impart knowledge on analog circuit to solve real-life problems
- Impart knowledge in making electronic systems

1. **Amplifiers:** Single stage and multistage amplifiers, feedback in amplifiers.
2. **Op-Amp:** Ideal and practical Op-Amp characteristics, Op-Amp characterization, Frequency response and dominant-pole compensation, Characteristics of inverting and non-inverting circuits of Op-Amp.
3. **Op-Amp applications:** System Poles and Zeros, Active filters, Butterworth filters, Chebychev filters, Sallen-Key Configuration, State variable analysis and state variable filter, Integrator, Differentiator, Solution of 2^{nd} order differential equation, Log/Antilog amplifiers, Active clippers, Active clampers, Comparators (window comparator, conversion of Sine-wave to Square-wave), Active peak detector, Absolute value circuit.
4. **Oscillators**: Positive feedback, Conditions of sustained oscillation, Stability, Noise, Function generators (sin, triangular sawtooth, VCO), Multivibrators.
5. **Conversion:** Frequency to voltage converter, Voltage to frequency converter.
6. **PLL:** Block diagram of PLL, Theory of PLL, and PLL construction using IC 565.

Recommended Books:

1. Integrated Electronics, Millman, Halkias, **McGraw Hill**
2. Electronic Principles, A. Malvino, D. J. Bates, **Tata McGraw Hill**
3. Electronic Circuits, Donald A Neamen, **Tata McGraw Hill**

Semester – I: ELTC 222 112: Semiconductor Devices and Materials

Course Outcome:

Students after successfully completion of the course will be able to:

- Understand the physics that influences the presence of charge carriers in a semiconductor
- Describe the factors that influence the flow of charge in semiconductors
- Describe the operation of semiconductor devices

- Calculate voltage and current changes in semiconductor devices
- Understand the nature of semiconducting materials

1. **Materials:** Crystalline, polycrystalline and amorphous semiconductors, energy bands, Brillouin zones , Wigner-Seitz cells, reciprocal lattice vectors, direct and indirect band-gap semiconductors, degenerate and non degenerate semiconductor, organic semiconductors, density of states, effective mass, carrier transport in strong electric and magnetic fields, transport in excess carriers, carrier injection (low and high) and recombination of the excess carriers, the mechanisms involved, thermal properties of materials, phonons and lattice vibration, glasses and amorphous solids, Fermi-levels, dominant relaxation processes in different materials at different temperatures, processes of recombination, formation of low dimensional semiconductor structures, sub-band energy and density of states, transport in quantum well hetero-structure, energy bands in super lattices and their device applications, electrical conduction in polymers and ceramics, super-ionic conduction mechanism, metallic glasses, optical properties of materials, absorption of light by inter-band and intra-band transition, dielectric materials and glass fiber, phenomenon of superconductivity, Meissner effect, superconducting transitions, flux quantization, Josephson's super conductor, high-Tc super conductor.
2. **Basic equations for semiconductor device operations:** continuity equation, current flow equation, carrier transport equation and their solutions. Binary, ternary and quaternary compounds and their applications. Characterization of semiconducting materials.
3. **p-n Junction diodes and solar cell:** Derivation of Schokley equation (ideal case), Temperature dependence of I-V characteristics of p-n junction diode, Junction capacitances, abrupt and linear, breakdown diodes, tunnel diode, Schottky barrier diode, majority carrier diodes.
4. **Photoconductors and Solar Cell:** Basic principle of operation, resistance-illuminance relation of photoconductor, materials and applications of photoconductor and solar cell.
5. **Microwave diodes:** Varactor diode, p-i-n diode, transferred electron devices.
6. **FET:** Characteristics and equivalent circuits of JFET, MESFET, MOS capacitor, MIS diode, MOSFET, Basic idea of charge coupled Devices, Quantum well structures and low dimension physics.

Recommended Books:

1. Semiconductor Physics and Devices, Islam, **Oxford**
2. Physics of Semiconductor Devices, S. M. Sze, **Wiley**
3. Physics of Semiconductor Devices, Shur, **PHI**

Semester – I: ELTC 222 113: Mathematical Methods in Electronics

Course Outcome:

Students after successfully completion of the course will be able to:

- Analyze real world scenarios to recognize when vectors, matrices, or linear systems are to be used for modeling
- Analyze linear algebra concepts that are encountered in the real world, understand Complex variable
- Acquire knowledge about derivative and partial derivative
- Acquire knowledge about Laplace transform and Fourier series, Fourier Transform

1. **Linear Algebra**: Matrix Algebra, Systems of linear equations, Eigen values and eigenvectors.
2. **Calculus**: Multiple integrals, Fourier series, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green's theorems, Methods of numerical differentiation and integration, interpolation and extrapolation, Monte Carlo simulation.
3. **Differential equations**: First order equation (linear and nonlinear), Higher order linear differential equations with constant coefficients, Method of variation of parameters, Cauchy's and Euler's equations, Initial and boundary value problems, Partial Differential Equations and variable separable method, some applications in electronics.
4. **Complex variables**: Analytic functions, Cauchy's integral theorem and integral formula, Taylor's and Laurent's series, Residue theorem, solution integrals.
5. **Transform Theory**: (a) Laplace transform: Time domain response of circuits, Convolution integral and its application to circuits, (b) Fourier Analysis: Steady state response, (c) Fourier transform: Frequency domain transform.
6. **Probability and Statistics**: Sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Discrete and continuous distributions, Poisson, Normal and Binomial distribution, Correlation and regression analysis.
7. **Classical Mechanics**: Generalised co-ordinate, Hamilton's principles, Lagranges equations from Hamilton's principle, Applications in electronics, Collision problems, scattering in a central force field, scattering cross-section, small oscillations, frequencies of free vibration, normal co-ordinate, normal modes, concept of phonon.

Recommended Books:

1. Higher Engineering Mathematics, B. S. Grewal, **Khanna Publication**
2. Mathematical Physics, B. D. Gupta, **Vikas**
3. Fundamentals of Electric Circuit Theory, Chattopadhyay, Rakshit, **S. Chand Publication** (for section 5).

Semester – I: ELTC 222 124: Lab 1: Analog Circuits and Devices

Course Outcome:

Students after successfully completion of the course will be able to:

- Impart knowledge on analog circuits
- Impart knowledge on circuit operation and functionality
- Impart knowledge on analog circuit to solve real-life problems
- Impart knowledge in making electronic systems
- Impart knowledge on Solar Cell
- Impart knowledge on Photoconductor
- Impart knowledge on pn junction

The following or similar experiments will be offered under this Practical Paper.

Group-A

1. Experimentation of Op-Amp characteristics measurements (R_{in}, R_{out}, Gain-Bandwidth product, CMRR and Slew Rate).
2. Experimentation of Shallen-Key (Butterworth): LPF.
3. Experimentation of Shallen-Key (Butterworth): HPF.
4. Experimentation of Voltage to Frequency converter.
5. Experimentation of Frequency to Voltage converter.
6. Experimentation of Active Integrator and Differentiator.
7. Experimentation of Active Clipper and Clamper.
8. Experimentation of on Square and Triangular wave generation using Op-Amp.
9. Experimentation of PLL (IC 565).

Group-B

10. Experimentation of double stage RC coupled amplifier.
11. Experimentation of Regulated power supply (78XX or 79XX).
12. Experimentation of Regulated power supply (317).
13. Experimentation of Diac characteristics.
14. Experimentation on Triac characteristics.

Group-C

15. Solar Cell: V-I characteristics under illumination and dark condition; measurements of various parameters.
16. Photoconductor: Experiment with photo conductor; measurement of gain and response time.

Semester – II

Semester – II: ELTC 222 121: Digital Circuits

Course Outcome:

Students after successfully completion of the course will be able to:

- Acquire the basic knowledge of digital logic levels and understand digital electronics circuits
- Convert different type of codes and number systems which are used in digital communication and computer systems
- Impart knowledge on design of Digital Circuits

1. **Introduction:** Introduction to Digital Systems, Boolean algebra and minimization.
2. **D/A and A/D Converters:** Weighted resistor and R-2R ladder type D/A converters and their comparison; Parallel-comparator type; Successive approximation type; Dual slope; Counting A/D converters and their comparison, Specification of D/A Converter, Introduction to DAC 0800, ADC 0804 and ADC 0808/0809.
3. **Memories:** The role of memories in Computer System, Memory types and terminology, Memory organization, Address decoding, Access times, ROM, PROM, EPROM, RAM, Charge-Couple Devices (CCD), Introduction of several ICs used as memory and CCD.
4. **Combination of logic gates:** Implementation of Switching function using AND-OR, NAND-NOR, NANDS AND NORs logic gates, Adders, Subtractors, Look-Ahead carry adder, Carry save adder, BCD-adder, multiplier, PAL, PLA, ALU.
5. **MUX and DMUX**: Multiplexer, Demultiplexer, Encoder, Decoder, Parity Checker & Generator, Introduction of related ICs
6. **Sequential Circuits:** Registers; Counters; Synchronous and Asynchronous sequential circuit design.
7. **Multivibrators:** Multivibrators and Clock circuits.
8. **Digital Display**: LED, 7-segment, LED display, Dot matrix display, Multiplexed display circuits.

Recommended Books:

1. Digital Circuits (Vol.1 and Vol.2), D. Raychaudhuri, **Platinum Publishing**

2. Fundamental of Digital Circuits, Aanad Kumar, **PHI**
3. Digital Design, M. Morris Mano, **PHI**

Semester – II: ELTC 222 122: Network Analysis and Synthesis

Course Outcome:

Students after successfully completion of the course will be able to:

- Apply the fundamental concepts in solving and analyzing different Electrical networks
- Select appropriate and relevant technique for solving the Electrical network in different conditions
- Apply mathematics in analyzing and synthesizing the networks in time and frequency domain
- Estimate the performance of a particular network from its analysis

1. **Network Theorems:** Special network configurations; Superposition; Reciprocity; Generalised maximum power transfer theorems; Generalised Thevenin's, Norton's, Millman's and Tellegen's theorems; Applications.

2. **Two-Port Networks:** Equivalent circuits, two-port parameters, Topological descriptions of different commonly used networks, π to T and T to π conversions, reduction of complicated network, symmetrical network, Impedance, admittance, transmission and hybrid parameters; Matrix forms of input-output relations; Cascade, parallel and series connection of two ports; Iterative and image impedances; Characteristic impedance, driving point impedance and transfer impedances, Propagation function; Balanced and unbalanced networks; Bartlett's bisection theorem and its applications; Nonreciprocal and terminated two-ports, Gyrator; Negative Impedance Converter.
3. **Fitter circuits:** L fitter, π filter, Methods of development of different filters like high pass, low pass, band pass and band stop filter circuits.
4. **Transient Response of Circuits:** Laplace transformation; Transform of linear combinations and damped functions; Shifting, differentiation, integral, initial and final value theorems; Applications; RL, RC, RLC and multimesh circuits; Characteristic equation; Impulse response and transfer function; Convolution integral; s-domain circuit analysis; Time domain response from pole-zero plots; Fourier analysis for periodic signals; Fourier transform; Energy calculation in frequency domain.
5. **Synthesis of Two-Terminal Reactive Networks:** Foster's reactance theorem; Poles and zeros; Separation property; Foster and Cauer Canonic networks.
6. **Synthesis of RL, RC and RLC Networks:** RL driving-point impedance and admittance functions; RC driving-point impedance and admittance functions; Foster and Cauer type networks; Synthesis of RLC networks; Hurwitz polynomials; Positive Real Function.

Recommended Books:

1. Electric Circuits, Nahvi, Edminister, **McGraw Hill**
2. Circuit Theory (Analysis and Synthesis), A. Chakrobarti, **Dhanpat Rai**
3. Electric Circuit Theory, D. Chattopadhaya, P. C. Rakshit, **S. Chand**

Semester – II: ELTC 222 223: Signal and Control Systems

Course Outcome:

Students after successfully completion of the course will be able to:

- Demonstrate an understanding of the fundamentals of (feedback) control systems
- Determine and use models of physical systems in forms suitable for use in the analysis and design of control systems
- Express and solve system equations in state-variable form (state variable models)
- Determine the time and frequency-domain responses of first and second-order systems to step and sinusoidal (and to some extent, ramp) inputs.
- Determine the (absolute) stability of a closed-loop control system
- Apply root-locus technique to analyze and design control systems
- Communicate design results in written reports

Signal and Systems:

1. **Introduction:** Definitions and properties of Laplace transform, continuous-time and discrete-time Fourier series, continuous-time and discrete-time Fourier Transform, DFT and FFT, Sampling theorem.
2. **Linear Time-Invariant (LTI) Systems:** definitions and properties; causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay. Signal transmission through LTI systems.
3. **Z-transformation:** Definition, mapping between s-plane and z-plane, unit circle, convergence and ROC, properties of z-transform, z-transform on sequences with examples and exercises, characteristic families of signals along with ROCs, convolution, correlation and multiplication using z-transform, initial value theorem, Persevals relation, Inverse z-transform by contour integration, power series & partial-fraction expansions with examples and exercises.

Control Systems:

1. **Introduction to Control Systems:** Introduction to automatic control, open loop and closed loop control systems, Mathematical modeling of a system: Block diagrams, Signal flow graph and its construction; Mason's gain formula, Different feedback characteristics of control system.

2. **Controllers:** Error amplifier, on-off controller, Proportional (P), Proportional-Integral (PI), Proportional-Derivative (PD), PID controllers. Dynamic behavior of control systems, servomechanism characteristics parameters of control systems – Accuracy, Sensitivity, Disturbances, Transient response, **Stability** – Routh-Hurwitz criterion, Bode plots, Nyquest criterion, controlling speed.
3. **Root Locus Analysis and design:** Root-locus principles; rules for root-locus construction; construction techniques of root-locus; properties of root-locus and root-locus design.
4. **Introduction to Digital Control system:** PLC & Application Case Studies: Speed control of DC Motors, Temp control. Fuzzy logic.

Recommended Books:

1. Signal and Systems, H. P. Hsu, **Tata McGraw Hill**
2. Signal and System, Oppenheim, Willsky, Nawab, **PHI**
3. Control Systems engineering, Nagrath & Gopal, **New Age**
4. Modern Control Engineering, Ogata **PHI/Pearson**

Semester – II: ELTC 222 124: Programming Language C/C++

Course Outcome:

Students after successfully completion of the course will be able to:

- Understand Machine and assembly language, High level programming language
- Understand dynamic memory management techniques using pointers, constructors, destructors etc
- Understand serial and parallel port C programming for interfacing with PC

1. **Introduction:** Machine Language, Assembly Language, Low-level language, High-level programming Language, Programming structures (top-down),
2. **Introduction to C:** Data types in C, Storage class in C, Operator and its precedence, Decision making and forming loop in programming.
3. **C programming:** Handling characters, Arrays, Structures, Unions, User defined function, Pointers, Pointer to structure, pointer to functions, Dynamic data structures, file I/O handling.
4. **Port programming:** Serial and parallel port C programming for interfacing with PC.
5. **C++ Language:** Introduction to C++, input and output formats, class in C++.
6. **Practicing C/C++:** Problem solving practice with PC.

Recommended Books:

1. Schaum's Outline of Theory and Problems of Programming with C, B. S. Gottfried, **Tata McGraw Hill**

2. Object Oriented Programming in Turbo C++, Robert Lafore, **Galgotia Publications**
3. Dada structure using C and C++, Y. Langsam, M. J. Augestein and A. M. Tenenbaum, **PHI**

Semester – II: ELTC 222 125: Lab 2: Digital Circuits and Fault Diagnosis

Course Outcome:

Students after successfully completion of the course will be able to:

- Design Combinational circuits
- Design Sequential circuits

The following or similar experiments will be offered to students under this Practical paper.

A. Combinational

1. Design a multiplier circuit using the 4-16 line decoders (74154) that will multiply two bit binary number
2. Keyboard encoder design using a decoder and a multiplier.
3. Using parallel connection method of 7485 IC chips to compare two 9 bit binary numbers.
4. Design a parallel binary multiplier for the multiplication of two 4 bit numbers , using the 4 bit CLA address IC 7483 or 74283 and a number of sufficient number of NAND gates.
5. Design a four digit multiplexed LED display using a single common anode BCD to seven segment decoder drive (7447).
6. Design a logic circuit using a decoder and necessary logic gates to allow the 4 bit binary numbers that are divisibly by three but less than or equal to 12 and greater than two.
7. Construct a circuit that add two BCD numbers and produces a BCD sum.

B. Sequential

8. Design a 4 bit synchronous counter which should start continue from 5 when the power is switched on to the counter and should count up to 10 ,after which should count down to 5 again. This process of counting from 5 to 10 and back should continue so long as power is on. Draw and explain the logic circuit & logic diagram for this circuit.
9. Implement a logic circuit of hybrid MOD-10 counter.
10. Mod 64 BCD counter using 74160 ICs.
11. Design a MOD-10 counter using 74190 counters .Use both up & down counting mode .Show the counters sequence.
12. A 4 bit up/down counter using Ex-OR gates between two consecutive T-flip-flops.
13. 4 bit bi-directional shift register using 4 D-flip-flops & 4-2:1 multiplexer.

14. Shift register Experiments

15. Ring counter experiment

C. Fault Diagnosis

16. Tracing the circuit of defective instrument

17. Identification of the defects

18. Reparing of the defects

19. Testing the repaired instrument

20. Making a report of the whole work

Semester – III

Semester – III: ELTC 222 211: Electromagnetic Field and Radiation

Course Outcome:

Students after successfully completion of the course will be able to:

- Understand Maxwells's equation in time varying field
- Understand concepts of different coordinate systems, static electric and magnetic fields and methods of solving for the quantities associated with these fields, time varying fields and displacement current, propagation of electromagnetic waves and their applications in practical problems
- Learn RF/microwave analysis methods and design techniques
- Understand an overview of Passive and active devices

1. **Review:** Maxwell's equations, pointing theorem, wave propagation in different media, propagation through ionosphere, effects of earth's magnetic field on ionospheric propagation.
2. **Transmission Line:** Transmission Line Parameters, Impedance Matching, Smith Chart.
3. **Wave Guide:** Wave propagation in rectangular and cylindrical wave guides, wave guide modes, wave guide coupling, excitation of modes, power transmission and looses, impedance measurements.
4. **Antenna** – Antenna parameters, Half-wave antenna, Antenna with parabolic reflectors, horn antennas, lens antennas. Wide band and special purpose antennas, Helical antennas, Discone antenna, Log-periodic antennas, Loop antennas, Practical transmitting antennas, Behaviour of receiving antennas, Microstrip Patch Antenna, Printed Dipole, Conformal Antenna.
5. **Microwave** – Introduction to microwaves and their applications; Klystron amplifiers: operation and analysis, power and efficiency, multi cavity klystron. Reflex klystrons: operation and analysis, electronic admittance, electronic tuning, power output and efficiency. Magnetrons: operation and analysis. Travelling wave tubes: operation, gain bandwidth, coupling and focusing methods, applications. Avalanche Diode, Gunn effect and Gunn diode oscillators. Solid state microwave amplifiers, oscillators (IMPATT & MESFET) and mixers. Microwave components: attenuator, phase shifter, slotted lines, frequency meter,

directional couplers, E-plane Tee, Magic Tee and Ferrite devices; Basic measurements of frequency, SWR, impedance and power at microwave frequencies; Principles of microwave LOS communication. Introduction to RADAR.

Recommended Books:

1. Antenna Theory and Design, Elliott, **Wiley**
2. Foundation of Microwave Engineering, R.E. Collin, **Wiley**
3. Microwave Engineering, D.M. Pozar, **Wiley**

Semester – III: ELTC 222 212: Electronic Communication Techniques

Course Outcome:

Students after successfully completion of the course will be able to:

- Understand different blocks in communication system and how noise affects communication using different parameters
- Distinguish between different amplitude modulation schemes with their advantages, disadvantages and applications
- Analyze generation and detection of FM signal and comparison between amplitude and angle modulation schemes
- Understand PCM, DPCM, ASK, FSK, PSK

1. **Random signals and noise:** probability, random variables, probability density function, autocorrelation, power spectral density.
2. **Analog communication systems:** Amplitude and angle modulation and demodulation systems, spectral analysis of these operations, superheterodyne receivers; elements of hardware, realizations of analog communication systems; TDM, FDM, signal-to-noise ratio (SNR) calculations for amplitude modulation (AM, QAM) and frequency modulation (FM) for low noise conditions. PAM, PPM, PWM, Fundamentals of information theory and channel capacity theorem.
3. **Digital communication systems:** Pulse code modulation (PCM), differential pulse code modulation (DPCM), Delta modulation, Adaptive Delta Modulation, Digital modulation schemes: amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK), matched filter receivers, bandwidth consideration and probability of error calculations for these schemes. Basics of TDMA, FDMA and CDMA and GSM.

Recommended Books:

1. Principles of Communication Systems, Taub, Schilling, Saha, **Tata McGraw Hill**
2. Communication Systems, Simon Haykin, **Wiley**
3. Modern Digital and Analog Communication Systems, Lathi**, Oxford**
4. Digital Communications, Ch. K. Rekha, **Scitech**

Semester – III: ELTC 222 213: Quantum and Optoelectronics

Course Outcome:

Students after successfully completion of the course will be able to:

- Acquire fundamental understanding of the basic physics behind optoelectronic devices
- Develop basic understanding of light emitting diodes
- Develop detailed knowledge of laser operating principles and structures
- Acquire in depth understanding of photodetectors
- Describe basic laws and phenomena that define behaviour of optoelectronic systems
- Use optical fibre equipment, and data transfer using optical fiber

1. **Quantum Physics:** Basic postulates of quantum mechanics, Dynamical variables, Outcome of measurements, Linear operators, Eigen values and Eigen vectors, Completeness, Orthogonality, Normalization, Discrete and Continuous spectra.
2. **Equation of motions:** Schrodinger, Heisenberg and interaction pictures, some exactly solvable problems, bound and unbound states, reflection and transmission in potential barriers, harmonic oscillator, Dirac's notation, some approximation methods for bound states, time-independent problems with stationary perturbation theory, time-dependent perturbation theory, Fermi-Golden rule, matrix elements, problem of collision of current carriers with crystalline imperfection in a material, some time-dependent approximation methods, Variational methods, WKB approximation.
3. **Introduction to Fiber Optic Communication**: Importance, Generation of fiber optic communication.
4. **Optical Fiber:** Classification of optical fibers, Light propagation in optical fiber, Optical fiber as cylindrical waveguide, Modes, Characteristics parameters, Fiber Losses, Dispersion, Fiber losses, fiber splicing, Noise control in optical fibers.
5. **Optical Sources:** LED characteristics, Characteristics of LED-based transmitter, Spontaneous emission, Stimulated emission, Einstein's co-efficients, light amplification, lasing condition, population inversion, line broadening mechanisms, rate equations, three and four level systems, variation of laser power around threshold, optical resonators, quality factor, stability of resonators, mode selection, mode locking, q-switching, Semiconductor Diode LASER, Amonioum laser, Ruby laser, He-Ne Laser,

application of lasers.

6. **Photodetectors:** p-n photodiode, characteristics of optical receivers, PIN photodiode, Phototransistors
7. **Devices:** Optocouplers, Fiber Optic Switches, Repeaters, Amplifiers.
8. **Fiber Optic Communication System:** Coupling to and from the fiber, Modulation, multiplexing and coding, Repeaters, Bandwidth and Rise-time budgets.
9. **Measurements:** Numerical aperture of optical fiber, Fiber attenuation, Bending losses, Bandwidth measurement.

Recommended Books:

1. Optical Fibers and Fiber Optic Communication Systems, Subir K. Sarkar, **S. Chand**
2. Fiber-Optic Communication Systems, Govind P. Agrawal, **Wiley**
3. An Introduction to Fiber Optics, A Ghatak and K. Thyagarajan, **Cambridge University Press**

Semester – III: ELTC 222 214: Digital Signal Processing

Course Outcome:

Students after successfully completion of the course will be able to:

- Interpret, represent and process discrete/digital signals and systems
- Determine the discrete Fourier transform of discrete-time signals
- Design & analyze DSP systems like FIR and IIR Filter

1. **Discrete-time signals:** Concept of discrete-time signal, basic idea of sampling and reconstruction of signal, Sampling Theorem sequences – periodic, energy, power, unit-sample, unit-step, unit-ramp, real & complex exponentials, arithmetic operations on sequences.
2. **Discrete Fourier Transform:** Brief recapitulation of Fourier Series, Concept and relations for DFT/IDFT, Twiddle factors and their properties, computational burden on direct DFT, DFT / IDFT as linear transformations, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circular convolutions, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequences – Overlap-Add & Overlap Save methods with examples and exercises.
3. **Fast Fourier Transform:** Radix-2 algorithm, decimation –in time and decimation-in-frequency algorithms, signal flow graphs, Butterflies, computation in one place, bit reversal, examples and exercises.
4. **Filter Design:** Basic concepts behind IIR and FIR filters, Butterworth IIR analog filter, Impulse Invariant and Bilinear transforms, design of IIR digital filter, design of linear phase FIR filter with

rectangular window.

5. **Digital Signal Processor:** Elementary idea about the architecture and important instruction sets of TMS320C 5416/6713 processor (any one), writing of small programs in Assembly Language.

Recommended Books:

1. Digital Signal Processing – Principles, Algorithms and Applications, J.G. Proakis, D.G. Manolakis, **Pearson Education/PHI**
2. Digital Signal Processors Architectures, Implementations and Applications, S.M. Kuo, W. Gan, **Pearson Education**

Semester – III: ELTC 222 215: Lab 3: Electronic, Fiber Optic and Microwave Communication

Course Outcome:

Students after successfully completion of the course will be able to:

- Understand the operation of Electronic Communication trainer kit
- Understand the operation of Optical Communication trainer kit
- Understand the experiments on Microwave Communication

The following or similar experiments will be offered to the students under this Practical paper.

A. Electronic Communication

1. Amplitude Modulation/Demodulation using Trainer Kit.
2. Frequency Modulation/Demodulation using Trainer Kit
3. ASK Modulation/Demodulation using Trainer Kit
4. PSK Modulation/Demodulation using Trainer Kit
5. PWM Modulation/Demodulation using Trainer Kit
6. PAM Modulation/Demodulation using Trainer Kit.
7. PCM Modulation using Trainer Kit
8. FSK Modulation/Demodulation using Trainer Kit

B. Optical Communication

9. Experiments on Analog Optical Communication using Trainer Kit
10. Experiments on Digital Optical Communication using Trainer Kit
11. Experiments with laser: Acquaintance of laser safety criteria, alignment of laser, setting up of a beam expander, power distribution of the beam, spot size, coherence length, divergence angle etc.

C. Microwave Communication

12. Microwave measurements: Power, Frequency, Wavelength, Impedance, Attenuation etc.

Semester – IV

Semester – IV: ELTC 222 221: Instrumentation

Course outcome:

Students after successfully completion of the course will be able to:

- Impart knowledge on electronic measurement system
- Impart knowledge on the methods of measuring different physical quantities
- Impart knowledge on measuring instruments

1. **Introduction:** Brief introduction of measurement system, Static and dynamic characteristics of instrument.
2. **Transducers:** Types, Resistance, Inductance, Capacitance, Piezoelectric, Thermoelectric, Hall effect, Photoelectric, Techogenerators, Measurement of: displacement, velocity, acceleration, force, torque, strain, speed, sound, temperature, pressure, flow, humidity, thickness, p^H, position.
3. **Test and Measuring Equipment:** Measurement of R, L and C, Bridge and Potentiometers, voltage, current, power, energy, frequency/time, phase, DVMs, DMMs, DSO, Logic probes, Logic State Analyzer, Spectrum Analyzer, Noise and interference in instrumentation, Instrumentation Amplifiers.
4. **Analytical Instruments:** Biological Instruments: ECG, Blood pressure measurements, spectrophotometers, Electron Microscope, X-ray diffractometer, Gas Chromatography.

Recommended Books:

1. Instrumentation and Control Systems, Katta Narayan Reddy & Palakodeti Sri Rama Krishnudu, **Scitech Publication**
2. Modern Electronic Instrumentation & Measurement Technique, Helfrick & Cooper, **PHI**
3. Fundamentals of Industrial Instrumentation, Alok Barua, **Wiley**
4. Electrical and Electronic Measurements and Instrumentation, A. K. Sawhney, **Dhanpat Rai**

Semester – IV: ELTC 222 222: Microprocessor and Microcontroller

Course Outcome:

Students who successfully complete the course will be able to:

- Describe the general architecture of a microcomputer system and architecture & organization of 8085 and understand the difference between 8085 and advanced microprocessor
- Understand and realize the Interfacing of memory & various I/O devices with 8085 microprocessor
- Understand and classify the instruction set of 8085 microprocessor and distinguish the use of different instructions and apply it in assembly language programming
- Understand the architecture and operation of Programmable Interface Devices and realize the

programming & interfacing of it with 8085 microprocessor

- Understand basic architecture of 16 bit and 32 bit microprocessors
- Understand interfacing of 16 bit microprocessor with memory and peripheral chips involving system design
- Understand techniques for faster execution of instructions and improve speed of operation and performance of microprocessors
- Understand RISC and CISC based microprocessors
- Understand about the concepts and basic architecture of 8051
- Write assembly language program in 8051 for various embedded system applications
- Understand interfacing of different peripheral devices to 8051

1. **Memory & their interfacing for 8085:** Interfacing of RAM, ROM, EPROM & DRAM etc. Battery backup of memories, EPROM programming algorithm & its software implementation.
2. **I/O interfacing technique:** Addressing the I/O devices, data transfer schemes-synchronous & asynchronous data transfer, interrupt driven data transfer, DMA.
3. **Support chips:** 8255, 8253, 8251, 8279, 8259, 8237, 8212.
4. **Interfacing of DAC, ADC, keyboards, printer, and displays using 8255 with 8085.**
5. **Architecture of 8086/8088 microprocessors:** 8086-pin assignment, addressing modes, software model, instruction sets, classification of instructions, assembly language programming, memory interfacing, interrupts, I/O interfacing, interfacing of support chips, interfacing of ADC, DAC , keyboards, displays etc.
6. **Introduction to Microcontroller:** 8051 microcontroller, 8051 pin description connection, I/O ports memory & memory organization, addressing modes & instruction set, 8051 assembly language programming, interrupts-a few applications of Microcontroller.
7. **Industrial applications of Microcontroller:** Traffic Control, Stepper motor, Scrolling

Recommended Books:

1. Microprocessor Architecture, Programming & Application, R. Gaonkar, **Wiley**
2. Microprocessors and Microcontrollers, N. Senthil Kumar, M. Saravanan, S. Jeevanathan, **Oxford University Press**
3. 8086/8088 Family, The Design, Programming and Interfacing, Uffenbeck, **PHI**
4. Microcontroller & Microprocessor, Krishnakant, **PHI**
5. The 8051 Microcontroller, Kenneth Ayala, **Cengage Learning**

Semester – IV: ELTC 222 223: VLSI and Power Electronics

Course Outcome:

Students after successfully completion of the course will be able to:

- Acquire a clear idea about fabrication process of CMOS technology
- Know various logic methods and their limitations as well as the circuit design using VLSI Technology
- Know the principle of operation, design and synthesis of different power conversion circuits and their applications

A. VLSI:

1. **Introduction:** Era of integrated circuits, Introduction to IC technology.
2. **Passive device fabrication:** Fundamentals of passive device fabrication.
3. **VLSI Fabrication:** Introduction, Crystal growth, Wafer preparation, Oxidation, Diffusion, Ion implantation, Lithography, Epitaxy, Etching, Polysilicon and dielectric film deposition (isolation), Metallization, Yield and Reliability.
4. **MOS Operation and Fabrication:** Structure and characteristics of E-MOSFET and D-MOSFET, Operation of MOS transistor, Modeling of MOS (MOS transistor circuit model and Small-Signal equivalent model of MOSFET), Layout design rules, Brief of NMOS and CMOS fabrication, BiCMOS inverter and brief of BiCMOS fabrication.

B. Power Electronics

1. **Characteristics of solid state power devices:** Diac, Triac, SCR, UJT, Thyristors, Heat sinks for power devices.
2. **Regulated power supply:** Supply characteristics (Load & line regulation, output resistance, efficiency etc.), Shut regulators, Series regulators, Monolithic linear regulators (applications of 78XX, 89XX, 723).
3. **Circuits:** Full-wave rectification by SCR, Triggering, Converters, Choppers, Inverters, AC regulators, speed control of a.c. and d.c. motors, GTO switch.
4. **Control:** Stepper motor, Synchronous motor, Three-phase controlled rectifier, Switch mode power supply, uninterrupted power supply.

Recommended Books:

A: VLSI

1. Principles of VLSI and CMOS Integrated Circuits, R. Jain, A. Rai, **S. Chand**
2. Fundamentals of Semiconductor Fabrication, G.S. May, S.M. Sze, **Wiley**
3. CMOS VLSI Design: A Circuit & Systems Perspective, Neil H.E. Waste, K. Haase, D. Harris, A.

Banerjee, **Pearson Education**

B: Power Electronics

1. Electronic Devices and Circuits, A. K. Maini and V. Agrawal, **Wiley**
2. Electronic Principles, A. Malvino, D. J. Bates **Tata McGraw Hill**

Semester – IV: ELTC 222 224: Lab 4: Microprocessor and Microcontroller

Course Outcome:

Students after successfully completion of the course will be able to:

- Understand the operation of typical microprocessor trainer kit
- Solve different problems by developing different programs
- Develop the quality of assessing and analyzing the obtained data
- Understand about the concepts and basic architecture of 8051
- Write assembly language program in 8051 for various embedded system applications
- Understand interfacing of different peripheral devices to 8051

The following or similar experiments will be offered to the students under this Practical paper.

A. Microprocessor

1. Write an ALP to move data block starting at location 'X' to location 'Y' without overlap.
2. Write an ALP to move data block starting at location 'X' to location 'Y' with overlap.
3. Write an ALP to arrange 08-Bytes of data in descending order.
4. Write an APL to arrange 8-bytes of data in ascending order. The data is stored in memory location of which the starting address is 9050H.
5. Write an APL to convert BCD number to binary number.
6. Write an ALP to convert binary number to BCD number.
7. Write an ALP to add two BCD numbers.
8. Write an ALP to implement a counter '00-99' (UP COUNTER) in BCD.
9. Write an ALP to implement a counter 'FF-00' (UDOWN COUNTER) in HEX.
10. Write an APL to implement 'throw a dice' using interrupt.
11. Write an APL to implement a real time clock.
12. Write an APL to implement multiplication by shift and add method.
13. Write an APL to find the product of two unsigned binary numbers stored at location 'X' and 'X+1' using successive addition and store the result.
14. Write an APL to find the smallest of 'N' 1-byte numbers. Value of N is stored in location 'X' and numbers from 'X+1'. Display the number in data field and its address field.

15. Write an APL for HEX to ASCII character conversion.
16. Write an APL for ASCII to HEX conversion.
17. Generation and displaying of Triangular Wave in CRO by interfacing 8085-Trainer-Kit (use DAC at Port 3 of the trainer kit, connect 'Out2' of DAC to CRO).

B. Microcontroller

18. A set of 100 bytes of data is available in memory in the form of signed numbers. Write a program to find the sum of all positive numbers. Use 8051 Trainer-Kit.
19. Solve the following expression using 8051 Trainer-Kit:

$$F = \frac{C * 9}{5} + 32$$

20. Write an ALP for HEX to ASCII Character conversion using 8051 Trainer-Kit.
21. Write an ALP for ASCII to HEX conversion using 8051 Trainer-Kit.
22. Interfacing a 'Keyboard' with the 8051 Microcontroller Trainer Kit. Write ALP to test the 'Keyboard'.

Semester – IV: ELTE 222 225: Seminar

1. **Topic:** Many seminar topics will be given to the students at the beginning of 3rd semester and or at the beginning of 4th semester and one seminar topic will be allocated to each student.
2. **Presentation:** Each student needs to present seminar on their allocated topic. Additional time will be allocated for question answer session to each student.
3. **Evaluation:** Evaluation will be based on performance in the presentation examination.

Semester – IV: ELTE 222 226: Grand Viva

1. Evaluation: Evaluation will be based on performance in the grand viva examination.