VIDYASAGAR UNIVERSITY

MIDNAPORE -721 102, WEST BENGAL, INDIA

Post Graduate Syllabus

in

Electronics

Under Choice Based Credit System

(CBCS)

With effect from: 2018-19

Programme/Learning Outcome (P/LO)

Electronics is a modern subject of learning. Phenomenological changes are happening in the society with the advancement of Electronics. It is imperative to have skill manpower to accelerate the progress in our society. In this direction, MSc in Electronics course at Vidyasagar University is designed to impart basis as well as advance knowledge to the students for equipping themselves in the arena of Electronics.

The syllabus is framed up maintaining All India Level of Standard and based on Choice Based Credit System (CBCS). The syllabus is portioned judiciously so that a student may have proper theoretical and practical knowledge of the modern subject. The syllabus gives strong Mathematical foundation, Computational skills, knowledge for Analog and Digital circuits, Materials science, Semiconductor science and devices, Optoelectronic devices, Control systems and Instrumentation, Communication systems and Networking, EM theory and radiating systems, VLSI designing and fabrication, and Microwave and Power Electronics. The syllabus offers two courses: Electronics and Electronic Waste Management, and Electromagnetic and Communication for CBCS. Project work / Industrial training is also incorporated in the syllabus to make a student competent in the real world. The syllabus is also structured to facilitate students for research works, industrial jobs, higher studies, entrepreneurship and different competitive examinations viz. NET, GATE, SET etc.

COURSE STRUCTURE M.Sc. in **ELECTRONICS**

SEMESTER	COURSE NO.	COURSE TITLES	Full Marks	Credit
I	ELC 101	MATHEMATICAL METHODS	50	4
	ELC 102	NETWORK ANALYSIS AND SYNTHESIS	50	4
	ELC 103	ELECTRONIC MATERIALS	50	4
	ELC 104	ANALOG ELECTRONICS	50	4
	ELC 195	COMPUTATIONAL & PROGRAMMING LAB.(practical)	50	4
	ELC 196	ANALOG CIRCUIT AND DESIGN LAB.(practical)	50	4
		TOTAL	300	24
II	ELC 201	SIGNALS AND SYSTEMS	50	4
	ELC 202	SEMICONDUCTOR DEVICE	50	4
	ELC 203	DIGITAL ELECTRONICS AND INTRODUCTION TO DIGITAL COMMUNICATION	50	4
	C-ELC 204	INTRODUCTION TO ELECTRONICS AND ELECTRONICS WASTE MATERIAL MANAGEMENT(CBCS)	50	4
	ELC 295	DIGITAL ELECTRONICS LAB (practical)	50	4
	ELC 296	SEMICONDUCTOR DEVICE LAB(practical)	50	4
		TOTAL	300	24
III	ELC 301	ELECTROMAGNETIC THEORY AND RADIATING SYSTEMS	50	4
	ELC 302	COMMUNICATION SYSTEMS AND NETWORKING	50	4
	ELC 303	VLSI ENGINEERING	50	4
	C-ELC 304	*HISTORY OF ELCTROMAGNETIC AND COMMUNICATION(CBCS)*	50	4
	ELC 395	VLSI LAB	50	4
	ELC 396	COMMUNICATION LAB	50	4
		TOTAL	300	24
IV	ELC 401	MICROWAVE AND POWER ELECTRONICS	50	4
	ELC 402	MICROPROCESSOR AND ITS APPLICATIONS	50	4
	ELC 403	CONTROL SYSTEMS AND INSTRUMENTATIONS	50	4
	ELC 404	OPTICAL COMMUNICATION AND INFORMATION PROCESSING	50	4
	ELC 495	MICROPROCESSOR LAB	50	4
	ELC 496	PROJECT WORK/INDUSTRIAL TRAINING	50	4
		TOTAL	300	24
		ALL TOTAL	1200	96

Full Marks, 50 = END SEMESTER WRITTEN EXAMINATION (40) + INTERNAL ASSESSMENT (10)

Semester –I

Theory:

Paper: ELC 101:Mathematical Methods **Full Marks: 50** **Credit: 4**

(*University Written Examination-40 Marks & Internal Assessment- 10 Marks*)

Syllabus:

1. **Vector spaces and matrices:** Vector spaces of n dimensions, inner product, Schmidt's orthogonalisation, Schwarz and Bessel inequality. Hermitian and unitary matrices, eigenvectors and eigen values, diagonalization, unitary transformation. Cayley Hamilton theorem.
2. **Integral transforms:** Laplace transform: Properties of Laplace transform, Inversion formula, Convolution, Application to ordinary and partial differential equations; Fourier transform: Properties of Fourier transform, Inversion formula, Convolution, Parseval's relation, Application to ordinary and partial differential equations.
3. **Special Functions:** Legendre Equation: Generating function, Legendre functions of the first kind and second kind, orthogonal properties, Rodrigue's formula, Bessel Equation: Bessel function, Series solution of Bessel equation, Recurrence relations.
4. **Complex variables:** Function of a complex variable, Limit, Continuity, Differentiability, the definition of an analytic function, Cauchy-Riemann equation, construction of analytic function, complex integration, Jordan arc, Cauchy's theorem, Cauchy's integral formula, More's theorem, Liouville's theorem, Taylor's and Laurent's series.

Numerical Analysis

1. **Numerical arithmetic:** Representation of integers, real numbers, floating point representation, floating point operators, IEEE standards of floating point numbers, Absolute and relative error, Error propagation, stability and ill conditioning, Order of approximation, Truncation error.
2. **Numerical differentiation:** Derivatives from divided difference table, central difference formula.
3. **Numerical integration:** Trapezoidal rule, Simpson's One-third Rule, Simpson's Three-Eighths Rule, Newton-Cotes formula, Weddle's Rule.
4. **Interpolation and extrapolation:** Lagrange's, spline and rational function, interpolation and extrapolation.
5. **Solving of polynomial equation:** Bisection Method, Newton-Raphson Method, Regula-Falsi method.
6. **Solving set of linear equation:** Gauss and Gauss-Jordan methods, III conditioned systems.

7. **Ordinary differential equation:** Runge-Kutta method, Adams-Moulton, Adams-Bash forth method.

Probability and Statistics

Mean, median, mode and standard deviation; combinatorial probability, probability distribution functions - binomial, Poisson, exponential and normal; Joint and conditional probability; Correlation and regression analysis.

Course Outcome (CO):

After completion of the course **ELC-101**, students will be able to:

- Understand the different mathematical methods and their applications.
- Understand numerical arithmetic and various numerical techniques to solve different problems through numerical computation.
- Understand the basic concepts of probably and statistics.

Paper: ELC 102: Network Analysis and Synthesis Full Marks: 50 Credit: 4

(*University Written Examination-40 Marks & Internal Assessment- 10 Marks*)

Syllabus:

1. **Network Theorem:** Review of Kirchoff's laws, Node and Mesh Method, Network theorems (Thevenin, Norton, superposition, Maximum power transfer, and Reciprocity theorem in DC and AC circuits).
2. **Network Topology:** Concepts of Network Graphs, Terminology used in network graph theory, Topological description of different commonly used networks, Incidence Matrix, Tie Set and Cut set matrix. Relationship between sub matrix, Duality.
3. **Two Port Network:** Two port network concept, Z, Y, hybrid, and ABCD parameters. Π to T and T to Π conversions, reduction of complicated network. Image impedance of a network, symmetrical network, characteristic impedance and propagation constant of a network.
4. **Time response of Passive Circuits:** Transient Response of LCR circuits and their combination with DC and sinusoidal excitation. Self and Mutual inductance, coefficient of coupling, modelling of coupled coils, Tuned coupled coils.

5. **Filter circuits:** L filter, Π filter, Methods of development of different filters like high pass, low pass, band pass and band stop filter circuits.

6. **Network analysis using Laplace Transform:** Review of Laplace transform methods, Step and Impulse response of RLC circuits and their different combinations, Convolution.

7. **Network Functions:** Driving point and transfer impedance and admittance, Voltage and Current transfer Ratios, Concept of Poles and Zeros in network Function, Necessary condition of transfer functions, Natural response of network, Pole Zero Plot, Routh Hurwitz Criteria of stability of a network.

8. **Network Synthesis:** Definition of Positive Real Functions, Testing procedure for P.R. functions, Derivation of Synthesis technique for one port passive network (Foster and Cauer form), Synthesis of two-port networks by ladder technique.

Course Outcome (CO):

After completion of the course **ELC-102**, students will be able to:

- Acquire fundamental knowledge on network theorems, Network topology, Two-port network, Filters, Time and frequency response, Network functions, Network analysis using Laplace transform etc.
- Understand Foster and Cauer methods of network synthesis.
- Develop problem solving skills on network analysis and synthesis.

Paper: ELC 103: Electronic Material **Full Marks: 50** **Credit: 4**

(University Written Examination-40 Marks & Internal Assessment- 10 Marks)

Syllabus:

1. **Introduction:** Material Science and Engineering, Classification of engineering materials, levels of structure, Structure property relation in materials.
2. **Lattice defects:** classification of imperfection, point defect, line defects, planar defects. Color centers: F and V centers.
3. **Electrical properties of metals:** Conductivity, reflection and absorption, Fermi surfaces, thermo electric phenomena. Conduction in metals oxides, amorphous materials. classical free electron theory of metals, Drawbacks of classical theory, relaxation time, collision time and mean free path, electrical conductivity from quantum mechanical consideration, electron scattering and

resistivity of metals, qualitative discussion on the feature of the resistivity, electrical conductivity at low temperature, Boltzmann transport equation, Hall effects in metal, selection of electrical engineering materials

4. **Dielectric Properties of materials:** Macroscopic electric field, polarization, Types of polarization, internal fields in solid and liquid, dielectric constant of solid and polarizability, Behavior of dielectrics in alternating fields, Ferro electricity, anti Ferro electricity, phase transition, piezoelectricity.
5. **Optical properties of materials:** Optical constants and their physical significance, Kramers – Kronig Relations, Electronic inter bond and intra bond transitions Relations between Optical properties and band structure – colour of material (Frenkel Excitons), Bond Structure determination from optical spectra reflection, refraction, diffraction, scattering, dispersion, photoluminescence, Electroluminescence.
6. **Magnetic Properties of Materials:** Diamagnetism, paramagnetism, various contributions to para and diamagnetism, Adia- batic demagnetization, Paramagnetic susceptibility. Ferromagnetism, ferrimagnetisms, structure of ferrites ,Ferrites spin wave, curic point, temperature dependence of saturation magnetization, saturation magnetization at absolute zero, magnons and their thermal excitation, dispersion relation,
7. **Superconducting materials:** Superconducting states, Meissner effect Fluxoid, Penetration depth, Type-1 and Type-II semiconductors, BCS theory, Josephson Superconducting tunneling: DC and AC Jopshen effect, High T_c superconducting material.

Course Outcome (CO):

A new branch of study of Electronic materials is under the Materials Science. Physical and chemical aspects of materials and different structures of materials make the subject meaningful for new knowledge and applications. At the end of the course **ELC- 103**, students will:

- Be able to acquire basic to advanced knowledge of physics and chemistry of materials to their mechanical. electrical, dielectric, optical and magnetic properties.
- Have a clear concept on structure, properties, processing and performance of different electronic materials.
- Be powerful to decide proper materials for design and construction.

Paper: ELC 104: Analog Electronics **Full Marks: 50** **Credit: 4**

(University Written Examination-40 Marks & Internal Assessment- 10 Marks)

Syllabus:

1. **Diode:** ideal diode, thermal characteristic of junction diode, piecewise liner model, diode logic gates, clipper, clamper, voltage doublers.
2. **Bipolar Junction Transistor:** Transfer characteristic, current component of transistor, internal capacitances, CB, CE, CC mode of operations and comparisons, Emitter follower, Small signal analysis: h parameter, transistor hybrid parameter model, Analysis of transistor amplifier circuits using h parameter. Millars theorem and its dual, Darlington amplifier, Boots trapped Darlington amplifier.
3. **Biasing and Thermal Stabilisation:** Operating point, Bias Stability, Stabilisation against I_{CO}, V_{BE} and β. Study of fixed bias, Self bias, Voltage divider bias. Stability of collector current, Bias compensation, Thermal runway.
4. **MOSFET:** MOSFET operation, Small signal and large signal model, MOS switch, MOS amplifier, MOS biasing, CS, CD, and CG using MOSFET.
5. **Small signal Amplifiers:** CB,CE and CC amplifiers, derivation of voltage gain, current gain, input impedance and output impedance, frequency response characteristics, lower and upper half frequencies, bandwidth, and concept of wide band amplifier. Cascade amplifier, RC coupled amplifier,
6. **Feedback Amplifiers:** Feedback topologies, feedback amplifiers, determination of loop gain, stability of amplifier, Effect of feedback on amplifier poles, stability using Bode plot, Frequency compensation.
7. **Operational Amplifier:** Differential amplifier, Internal architecture OP-AMP, OP-Amp as Comparator, Schmitt triggers, Instrumentation Amplifiers, Logarithmic Amplifiers, Anti-log amplifiers, Multipliers, Divider.
8. **Voltage Regulator:** Regulated power supply, series regulation using OP-AMP, Monolithic voltage regulator, details of standard power supply unit, switch mode power supply (SMPS).
9. **Signal Generator:** Crystal oscillator, tuned oscillator, voltage controlled oscillator (VCO), pulse generator, ramp generator, square and triangular wave generator.
10. **Phase Locked Loop (PLL) & Applications:** PLL operating principles, monolithic PLLs. Applications of PLL - Frequency multiplication, tracking, FM demodulation.

ELC-104 Course Outcome (CO):

- Acquire basis concept of different electronic devices.
- Able to design amplifier circuits using Diode, BJT, MOSFET and OP-AMP and observe their different important characteristics.

- Observe the effect of negative feedback on different parameters of an amplifier and different types of negative feedback topologies.

- Learn about working of different oscillators and signal generators and voltage regulators.

- Acquire fundamental knowledge about PLL.

Practical:

Paper: ELC 195: Computation & programming laboratory (Practical)

Full Marks: 50 Credit: 4

Syllabus:

Apart from executing the programs prescribed in the syllabus, students should be encouraged to execute other problems associated with C Programming Language with similar complexity. Problems other than those listed below may also be set in final examination of similar complexity and conformity to the theory syllabus.

Write programs using C Programming Language to perform the following tasks:

List of Assignments:

1. Find factorial of an integer N where N may be read from the keyboard. Write the program (a) without using recursion and (b) using recursion.

2. Check a number N enter through keyboard is prime or non-prime.

3. Calculate the first N Fibonacci numbers where N may be read from the keyboard.

4. Check a number N enter through keyboard is Armstrong or not.

5. Convert decimal to binary and vise-versa.

6. Obtain the sum of the first N terms of (a) an A.P. series and (b) a G. P. series. Read the required variables from the keyboard.

7. Calculate the functions sin(x), cos(x) and exp(x) by representing each of them as an infinite series. Read in the value of the desired accuracy from the keyboard. Also find the numbers of terms calculated to achieve desire accuracy.

8. Sort an array of numbers in (a) ascending and (b) descending order using the Bubble sort algorithm.

9. (a) Given two m x n A and B matrices, calculate A + B and A – B. Read the individual elements from the keyboard.
(b) Given an m x k matrix A and a k x n matrix B, evaluate A*B.

10. Solve a given polynomial equation numerically using (a) Newtow-Raphson method (b) Bisection method. Read in the polynomial coefficients and accuracy from the keyboard.

11. Given a polynomial function f(x). Calculate using (a) Simpson's 1/3 rule (b) Trapezoidal rule the ∫f(x)dx within specified limits. Compare the answer with that obtained analytically.

ELC-195 Course Outcome (CO):

- Acquire complete knowledge of C language.
- Develop logic and technique to create programs in C language.
- Able to solve scientific and technical problems with C programming language.

Paper: ELC 196: Analog Circuit and Design laboratory (Practical)

Full Marks: 50 Credit: 4

Syllabus:

1. Fixed bias circuit of a BJT amplifier
Design a fixed bias transistorized amplifier and measure $V_{BE,}$ V_{CE}, V_{CB}, I_C, I_B, I_E at Q point. Repeat the same with different BJT.

2. Study of self biased transistorized amplifier.
Design a self bias transistorized amplifier and measure $V_{BE,}$ V_{CE}, V_{CB}, I_C, I_B, I_E at Q point. Repeat the same with different BJT.

3. Frequency response of voltage divider bias circuit of BJT using R_E unbypassed.
Study frequency response of voltage divider bias circuit of BJT.Measure midband gain, input impedance and output impedance.

4. Frequency response of voltage divider bias circuit of BJT using R_E bypassed.
Study frequency response of voltage divider bias circuit of BJT. Measure midband gain, input impedance and output impedance. Perform linearity test for given configuration.

5. Frequency response of emitter follower of BJT.

Study frequency response of emitter follower of BJT. Measure of mid band gain, input impedance and output impedance.

6. Design a R-C coupled amplifier of given gain using transistors in CE mode.
i) Study the frequency response and calculate its bandwidth.
ii) Connect a buffer (C-C amplifier) at the final stage and find its effect.

7. a) Construct a regulated power supply using a power transistor as a pass element and an op-AMP as a comparator.

8. Design an active first and second order Butterworth filter and study its frequency response characteristics and find the cut-off frequencies.

9. Design of RC phase shift oscillator.

10. Design and Integrator and Differentiator using OP-AMP and draw the transfer characteristics.

ELC- 196 Course Outcome (CO):

This is a practical paper on the design of analog circuits in advance level. In this practical paper students design filters, amplifiers using transistors, regulated power supply, and uses OPAMP to design circuits for integration and differentiation etc. The design process is carried out by using breadboard and discrete electronic components. At end of course the students are able:

- To correlate the theoretical concept of electronic circuit with practical feasibility.
- To acquire experience on electronic circuits for real life applications.

Semester-II

Theory:

Paper: ELC 201: Signals and Systems Full Marks: 50 Credit: 4

(University Written Examination-40 Marks & Internal Assessment- 10 Marks)

Syllabus:

1. **Introduction:** Signal definition, different type of signals: analog & discrete. Time domain and frequency domain representation, periodic and aperiodic signals, energy and power signal, deterministic and non-deterministic signal, signals and vector analogy, othogonality of signal functions, some useful signal operations,
2. **Sequences:** classification based on length, symmetry, periodicity, energy, power, generation of sequences, special sequences, arithmetic operations on sequences.
3. **Basis function and concept of generalized Fourier series:** Fourier transform of some useful functions, convolution and correlation in time domain and frequency domain. Perseval's theorem, energy spectral density, essential bandwidth of a signal, energy of the modulated signal, time autocorrelation function and the energy spectral density, power spectral density, time autocorrelation function of power signals, Input and output power spectral densities, psd of modulated signals.
4. **LTI Systems:** Convolution, graphical & analytical techniques, overlap & add method, sliding tape method, numerical problems on LTI systems, properties of convolution and interconnection of LTI systems, de-convolution, stability of systems, casual systems, recursive and non-recursive systems, difference equation, implementation of systems, direct Form I and II structures, concepts of IIR & FIR systems, moving average system.
5. **Discrete Fourier Transform:** DFT and IDFT relationship, Twiddle factors, linear transformations, basic properties, , multiplication of DFTs, circular convolution, linear filtering using DFT, filtering of long data sequences, overlap and save method, overlap and method.
6. **Fast Fourier Transform:** Efficient computation of DFT, FFT algorithms, Radix-2 algorithm, decimation in-time and decimation-in-frequency algorithms, signal flow graph, butterflies, computation in one place, bit reversal, DFT computations using DIT & DIF algorithms.
7. **Signal detection:** Model of digital communication system, geometric interpretation of signals, Schwarz’s inequality, concepts of orthogonality and orthonormality, Gram- Schmidt orthogonalization process, roles of multipliers and correlators, bank of correlators in noisy environment, channel characterization, likelihood functions, memory less channel, signal detection in presence of noise, maximum-likelihood detector, observation space, decision regions, conditional probability of symbol error, error function, complementary error function,

correlation receiver, matched filter receiver, maximization of signal to noise ratio, properties of matched filter.

Course Outcome (CO):

At the end of the course **ELC-201**, students will develop their:

- Basic concepts of different signals and systems in detail.
- Understanding to analyze various kinds of systems through proper use of Fourier transforms.
- Knowledge of signal detection in detail.

Paper: ELC 202: Semiconductor Device **Full Marks: 50** **Credit: 4**

(University Written Examination-40 Marks & Internal Assessment- 10 Marks)

Syllabus:

1. **Diode:** P-N junction diode, Energy band diagram, Depletion region and depletion capacitance, Abrupt junction, Diffusion potential and depletion layer width, linearly graded junctions, current voltage characteristics, Shockley equation, Diffusion capacitance, Junction breakdown, Tunnelling effect, Avalanche multiplication, Transient behaviour and noise. Varistor, Varactor, Charge Storage diode, P – I - N diode.
2. **Metal - Semiconductor Junction:** Energy band diagram, Surface states, Depletion layer, Schottky effect, Current transport processes. Thermionic emission theory. Diffusion theory, Tunnelling current, Minority carrier injection ratio, calculation and Characterization of barrier height, Ohmic contact.
3. **Bipolar Junction transistor:** Device modelling, Ebers - Moll model, Gummel – Poon model, Cut off frequency, Microwave transistor, Microwave characterization, Power transistor, Switching transistor, Hot – electron transistor.
4. **JFET and MESFET:** Basic characteristics, uniform charge distribution, arbitrary charge distribution. Field dependence mobility, Two-region model, Saturated velocity model, Microwave performance,' Related field effect devices, current limitation, Multichannel FET.
5. **Metal Oxide Semiconductor Devices:** MOS capacitor, energy band diagrams, accumulation, flat band, mid band, depletion, inversion, Formulation of Poisson’s equation: depletion approximation, exact solution,

LFCV and HFCV plots, analytical expression of capacitances, Non-idealities in MOS capacitors, LFCV and HFCV in non-ideal MOS capacitors, MOS parameter extraction from CV measurements, bulk traps, interface traps, experimental procedures of trap density extraction, gate material, poly-depletion effect, Mid-gap work function gate material, review of high-K gate dielectric materials, MOSFET: derivation of IV through gradual channel approximation, sub-threshold condition, sub-threshold slope, short channel effects in MOSFET, high-field and hot carrier effects, MOSFET scaling, SOI MOSFET.

6. **PNPN devices:** SCR, DIAC, TRIAC.

Course Outcome (CO):

After completion of the course **ELC-202,** the students will be able to:

- Acquire fundamental knowledge on P-N junction diode, Schottky diode, BJT, FET, MESFET, MOSFET etc. along with the high power and high frequency performances.

- Understand the PNPN power devices such as SCR, DIAC and TRIAC.

Paper: ELC 203: Digital Electronics and introduction to digital Communication

Full Marks: 50 Credit: 4

(University Written Examination-40 Marks & Internal Assessment- 10 Marks)

Syllabus:

1. **Introduction:** Extensive review on logic gates (using transistor, diode etc) & logic families (detail circuit analysis of RTL, HTL, TTL, NMOS, & CMOS Families.
2. **Combinational Circuit:** Serial adder, Parallel adder, ripple carry adder, carry look ahead adder, BCD to seven segment decoder, parity encoder, Parity generator and checker, code conversion(BCD to Binary & Binary to Gray),Magnitude Comparator, BCD adder.
3. **Sequential Logic system:** S-R,D,T,J-K flip-flop, Master –Slave connection, edge triggering , level Triggering, Timing diagram, Flip-Flop Conversion, Synchronous & asynchronous counter, Divide by N counter, Glitch elimination, register, shift register, preset & clear functions
4. Implementation of logic gates using CMOS.

5. **Multivibrator:** Astable & Monostable (principle, circuits & operation) timer circuit using 555 timers.
6. **Bipolar & MOS memories:** RAM, ROM, Introduction of several ICs used as memory. Charge couple device, PLD devices.
7. **D/A & A/D:** Specification of D/A converter, R-2R ladder type D/A converter, Successive approximation converter, The Dual slope converter.
8. **Introduction to Digital Communication:** Concepts of sampling in transmitting multiple band limited signals, Sampling theorem, channel bandwidth of PAM signal, crosstalk, concepts of signal reconstruction, quantization of signals, quantization error, PCM system, uniform and non-uniform quantization, companding, μ-law and A-law compressions, input-output characteristics, DPCM, DM, start-up, hunting, slope-overload error, ADM, algorithms for varying step size, Σ - Δ modulator, signaling formats –unipolar, bipolar, NRZ, RZ, Manchester and Gray with emphasis on power spectra, ISI, eye pattern, concept of equalization, linear transversal equalizer.

ELC-203 Course Outcome (CO):

- Acquire fundamental idea of logic gates using diodes and analysis of different logic families like TTL, ECL MOS etc.
- Obtain knowledge about different combinational logic circuits and sequential logic circuits.
- Acquire knowledge to design implementation of any logic expression using CMOS.
- Students are able to design different multi-vibrator circuits.
- Empowered the student to understand about memories and design ADC/DAC converters.
- Acquire fundamental knowledge of digital communication.

Paper: C-ELC 204: Introduction to Electronics and Electronic waste management (CBCS)

Full Marks: 50 Credits: 4

(University Written Examination-40 Marks & Internal Assessment- 10 Marks)

Syllabus:

1. Introduction to electronic materials.
2. Introduction to electronic devices and circuits: Basic concepts of diodes, transistors and its operation, diode circuits, amplifier, oscillator.

3. Introduction to digital electronics: number systems, binary addition, subtraction, combinational circuits, sequential circuits. Electronic Waste management: Definition of e-waste.
4. Measurement the e-waste flows: Calculation of sales and e-waste generated, Framework measuring e-waste flows.
5. The flow of e-waste: The e-waste trade, the international flow of e-waste, The illegal e-waste trade, Security implications. Electronic waste disposal systems, Chemicals of primary concern in e-waste,

   E-waste in India:
6. Growth of electrical and electronic industry in India, Environment concerns & health hazards,
7. Recycling e-waste: a thriving economy of the unorganized sector: Global trade in hazardous waste, Import of hazardous e-waste in India, E-waste economy in the unorganized sector, E-waste economy in the organized sector, E-waste projection and recycling in four major cities Delhi, Mumbai, Bangalore and Hyderabad.
8. Management of e-waste: E-waste legislation —introduction, Regulatory regime for e-waste - The Hazardous Waste (Management & Handling) Rules, 2003, The Hazardous Wastes (Management, Handling and Trans boundary Movement) Rules, 2008,. Guidelines for Environmentally Sound Management of E-waste 2008, The Draft E-waste (Management and Handling) Rules, 2010.
9. The international experience: The Basel Convention, The Bamako Convention, The Rotterdam Convention, Waste Electrical and Electronic Equipment (WEEE) Directive in the European Union. Government regulations on e-waste management in China and USA.
10. Case studies.

Course Outcome (CO):

The course **ELC-204** is offered for the CBCS. Basically this course is designed for students apart from the electronics discipline. After completion of the course, students will:

- Be more interested in electronics.
- Be concern about e-waste and its volume of generation in India and other countries.
- Be aware about the impact of e-waste on environment, health and society.
- Understand the role of different stakeholders for e-waste handling.
- Learn laws and management techniques to handle e-waste including Smart Cities, Make in India and Swachh Bharat Mission.
- Be able understand a real time problem by a case study.

Practical:

Paper: ELC 295: Digital Electronics **Full Marks: 50** **Credit: 4**

Syllabus:

1. Construction of simple arithmetic circuits-Adder, Subtractor.
2. Construction of two bit parity generator.
3. Construction of four bit comparator circuit.
4. Conversion of BCD to Binary & Vice Versa.
5. BCD to Decimal conversion to drive 7-segment display using MUX.
6. Design of RS, JK and MS flip flop.
7. Realization of MOD counter.
8. Realization of Ring counters.
9. Realization of Universal register using J-K & logic gate.
10. Realization of logic Gates using MOSFET.
11. Construct Astable Multivibrator using 555 timer.
12. Conversion of D/A using R-2R ladder.

ELC- 295 Course Outcome (CO):

This is a practical paper on the design of digital circuits in advance level. In this practical paper students design different combinational and sequential circuits like adder, subtractor, multiplexer, flip-flops, registrars, counters etc. The design process is carried out by using breadboard and ICs. At the end of the programme, students will:

- Learn to correlate the theoretical concept of digital circuits with practical feasibility.
- Gather on hand experience on digital circuits for solving real life problems.

Paper: ELC 296: Semiconductor Device laboratory (Practical)

Full Marks: 50 **Credit: 4**

Syllabus:

1. Measurement of resistivity of a SI-wafer using four probe methods and to determine band gap of the sample using temperature sensitive conductivity measurements.
2. Determination of carrier concentration, mobility of a semiconductor sample using Hall measurements.
3. Estimation of metal-semiconductor barrier height using AL-SI/AU-SI schottky diodes using activation energy methods.
4. Application of thermionic technique to estimate M-S barrier height from I-V measurement.
5. Determination ideality factor and reverse saturation current of a Si/Ge diode
6. Estimation of carrier concentration of a N type semiconductor of a $P^{+}N$ junction from C-V measurement.
7. Study temperature dependent threshold voltage of a Field Effect Transistor.
8. To study the output and transfer characteristics of a FET.
9. Modelling of I-V characteristics of P-N junction and Schottky diodes using C.
10. Study of transient response of a Schottky diode at higher frequencies.
11. Study of the operational characteristics of (i) SCR (ii) DIAC (iii) TRIAC

Course Outcome (CO):

After completion of the course **ELC-296**, students will be able to:

- Acquire hands on experience on the fundamental techniques such as Hall measurement, conductivity measurement using four-probe method, C-V measurement of a P-N junction, measurement of barrier height of a Schottky contact etc.
- Understand the device modelling techniques using C.

Semester-III

Theory:

Paper: ELC 301: Electromagnetic Theory and Radiating Systems

Full Marks: 50 Credit: 4

(University Written Examination-40 Marks & Internal Assessment- 10 Marks)

Syllabus:

1. **Introduction:** The equation of continuity for time varying fields, Inconsistency of Amperes Law, Maxwell's Equations, Conditions at a Boundary Interface.
2. **Wave propagation:** Wave propagation in free space, dielectric medium and conducting medium. Dielectric and Conductor. Depth of penetration. Reflection of wave by perfect conductor- normal and oblique incidence (Horizontal and Vertical Polarisation). Poynting theorem, Poynting vector, Flow of power.
3. **Transmission Line:** Frequency bands. Transients in transmission lines. Types of Transmission Line. Telegrapher's equation. Transmission Line Theory, Loss less transmission line, Terminated transmission line, Quarter wave transformer, Step up Transformer. Impedance matching, Stub matching, Smith Chart.
4. **Guided Waves:** Waves between parallel planes, TE modes, TM modes and TEM modes.
5. **Wave Guides:** Rectangular Wave Guide, Solutions of wave equations in rectangular coordinate.TM and TE modes in rectangular wave guide. Power transmission and losses in rectangular wave guide. Excitation of modes in rectangular wave guide. Characteristics of standard rectangular wave guide. Cylindrical Waveguide, Solutions of wave equations in cylindrical coordinate.TM and TE modes in cylindrical wave guide. Power transmission and losses in cylindrical wave guide. Excitation of modes in cylindrical wave guide. Characteristics of standard cylindrical wave guide.
6. **Radiation:** Potential functions and Electromagnetic field. Alternating current element, Hertzian dipole, Radiation from quarter wave monopole or half wave dipole.
7. **Antenna fundamentals:** Fundamental parameters of antenna- Radiation Pattern, Radiation Power density, Radiation Intensity, Beam-width, Directivity, Antenna efficiency, Gain, Beam efficiency, Polarization, Input impedance, Antenna radiation efficiency, Antenna effective wavelength and equivalent areas, Max. Directivity.
8. **Introduction to antennas:** Resonant and non resonant antennas, Wire antenna, Loop antenna, Horn antenna, Parabolic reflector, Lens antenna, Helical antenna, Log periodic or frequency independent antennas. Travelling Wave antenna.
9. **Radio Wave propagation:** Ground waves, Space wave, Ionospheric wave and their characteristics, reflection and refraction of radio waves in ionosphere,

critical frequency, skip distance, Maximum useable frequency, fading, secant law, duct propagation

ELC- 301 Course Outcome (CO):

This theory paper is on electromagnetic theory and radiating systems. This course contains basic and advance level theories on electrostatic, magnetostatic, electromagnetics, electromagnetic radiation and antennas. At the end of the course students will:

- Acquire knowledge on theoretical aspects of electrostatics, magnetostatics, electromagnetic theory and radiation.
- Learn different coordinate systems and vector calculus

Paper: ELC 302: Communication Systems and Networking

Full Marks: 50 Credit: 4

(University Written Examination-40 Marks & Internal Assessment- 10 Marks)

Syllabus:

1. **Analog communication systems:** Introduction to basic elements of communication systems.
2. **Signal transmission through linear systems:** condition for distortion less transmission of signals through networks. Different types of distortion and their effect on the quality of output signals, transmission of transient signals, distortion analysis.
3. **Amplitude modulation:** Modulation principle and definitions, sideband and carrier power, generation of AM signal, demodulation of AM signal. Different type of modulator circuits, square law modulator, balanced modulator, etc.. Demodulator basic principle of coherent detections, square law detectors, average envelope and peak envelope detectors. quadrature amplitude modulation (QAM), amplitude modulation: single sideband (SSB), generation of SSB signals, selective filtering method, phase shift method, demodulation of SSB-SC signals, envelop detection of SSB signals with a carrier (SSB+C), amplitude modulation: vestigial sideband (VSB), envelop detection of VSB+C signals, noise in AM receivers using envelope detection, concept of SNR.
4. **Frequency and phase modulation:** principles and definitions, relationship between frequency and phase modulations. phase and frequency deviations, spectrum of FM signal, bandwidth considerations. Effect of modulation index on bandwidth, narrow band and sideband FM and PM principles, circuit for realization of FM and PM.

5. **Principle of demodulation:** different type of demodulator, discriminator, use of PLL etc. Radio transmitter: Basic block diagram of radio transmitter (AM and FM), Analysis of a practical circuit diagram used for medium power transmitter.
6. Radio receiver Basic block diagram of TRF, superheterodyne principle, its advantages, Mixer principle and circuit.
7. **Digital modulation techniques:** Digital modulation formats, coherent systems – BPSK, BFSK, QPSK & MSK: signal constellation, average probability of symbol error, derivation of transmitter and receiver, non-coherent systems – BFSK & DPSK: derivation of transmitter and receiver, comparison of binary and quaternary modulation systems, introductory idea of GMSK, QAM & OFDM
8. **Information theory and coding:** Concept of uncertainty, discrete messages, amount of information, probability of occurrence, concept of binit, unit of information, Entropy, properties of entropy, information rate, source coding theorem, Shanon-Fano algorithm, Shanon's theorem, channel capacity, Gaussian channel, bandwidth-SNR trade off, Shannon's limit, introductory idea of linear block code, generator and parity-check matrices, encoder, error detection and correction, syndrome decoding, decoder.
9. **Data communication:** networks and services, application and layered architecture, OSI model, IEEE 802.3 and IEEE 802.11, Network topologies, LAN and MAC, Data link control, Bridging, switching, addressing, Transmission systems, circuit switching networks, routing, signalling and traffic management, Packet switching networks, TCP/IP and Internetworking, network architectures and protocols, ISDN

Course Outcome (CO):

After completion of the course **ELC-302,** the students will be able to:

- Acquire fundamental knowledge on analog communication system like AM, FM and PM. The various techniques of modulation and demodulation.
- Understand the digital modulation system including information theory and data communication.
- Develop problem solving skills on analog and digital communication systems.

Paper: ELC 303: VLSI Engineering **Full Marks: 50** **Credit: 4**

(University Written Examination-40 Marks & Internal Assessment- 10 Marks)

Syllabus:

1. **Introduction of VLSI:** Evaluation of VLSI, VLSI design flow, Y-chart, Moor's law
2. **Basics of MOSFET:** MOS capacitor, operation and characteristics of MOSFET, small and large signal model of MOSFET, MOS capacitances, spice models of MOSFET, MOSFET scaling, small channel geometry effect.
3. **Fabrication and Layout of MOSFET:** Basic steps in IC fabrication (wafer preparation, epitaxial growth, oxidation, photolithography, diffusion, ion implantation, isolation, metallization, packaging and testing).NMOS fabrication, CMOS fabrication process, twin tub fabrication process. SOI technology, various design rules for layout. Stick diagram, Eular rule for layout.
4. **Application specific IC:** semi custom ASIC, Full custom ASIC, Standard cell based ASIC, Gate array based ASIC.
5. **CMOS inverter:** Resistive load ,CMOS inverter(operation and characteristics, delay calculation)
6. **Analog VLSI Circuits:** Analog VLSI design steps ; Basic building blocks of Analog VLSI chips, MOS switch , Voltage dividers ,CMOS Current source & sink ,current mirror,, CMOS Voltage references/voltage dividers [Basic circuits only], CMOS Differential amplifier; Output amplifiers [Basic circuits only], CMOS OPAMP, Switched capacitor filter.
7. **Digital VLSI:** CMOS logic circuits, NAND & NOR Gates ,Complex logic circuits, CMOS Full Adder , CMOS Transmission GATE, Advanced CMOS Logic circuits; Sequential CMOS logic circuits; SR Latch circuit, clocked JK Latch/ Master-Slave JK, CMOS D-latch & Edge triggered flip-flop.

Course Outcome (CO):

VLSI Engineering course is designed to impart knowledge and skill on VLSI design and fabrication both. At the end of the course **ELC-303**, students will:

- Have comprehensive understanding on MOS physics, analog VLSI and digital VLSI circuit design and fabrication.
- Acquire in depth knowledge on IC fabrication and packaging.
- Achieve skills in developing the competence of using different methods in the domain of VLSI.
- Be suitably fit for various industries and higher studies.

Paper: ELC 304 History of Electromagnetic and communication (CBCS)

Full Marks: 50 Credit: 4

(University Written Examination-40 Marks & Internal Assessment- 10 Marks)

Syllabus:

1. Brief history to the development of electricity upto 18th century.
2. Evolution of Electromagnetic in 19th century: Ear& Experiments, Coulomb's Force Law, Galvanism and Electromagnetism, Electromagnetic Induction, Electrostatics and Magnetostatics, Ampere's Force Law, Ohm Law, Weber's Force Law, Faraday's Law, Electromagnetic Waves.
3. The Genesis of Maxwell's Equations: Faraday's Lines of Force, Physical Lines of Force, A Dynamical Theory of the Electromagnetic Field.
4. Maxwell, Hertz, the Maxwellians and the Early History of Electromagnetic Waves: Speculations of Electromagnetic Propagation Before Maxwell, Maxwell's Electromagnetic Theory of Light, Maxwell's Equations, Electromagnetic Waves, Oliver Heaviside, Heaviside's Life, Heaviside's Contributions- Transmission Lines, Maxwell's Equations, Operational Calculus, The Heaviside Layer.
5. Wireless before Marconi: Conduction Telegraph, Induction Telegraph, Electromagnetic Telegraph.
6. Nikola Tesla and His Contributions to Radio development: Invention of the Tesla Coil, Radio Controlled Vehicle, Colorado Springs Laboratory, Marconi and Braun Research, Long Island Laboratory.
7. J. C. Bose's Pioneering Work in Millimeter and Microwaves: A 60 GHz Transmission System, Development of the Receiver, Demonstration of Propagation, Demonstration of the Phenomenon of Refraction, Polarization, Photoelectric Effect, Measurement of Wavelength, Development of the Galena Detector, Biological Effects of millimeter Waves.
8. John Ambrose Fleming and development of wireless communication.
9. The Development of Wireless Telegraphy and Telephony and Transatlantic Wireless Communications : A Brief History of the Birth of Wireless, Experiments on Sparks and the Generation of Electromagnetic Waves, Early Receiving Devices, Continuous Wave Transmitters, Antenna Systems, Marconi's First Transatlantic Experiment, Marconi's Stations at Glace Bay, Transatlantic Experiments in the First Decade of the twentieth century- Marconi, Fessenden.
10. Modern wireless communication systems: Mobile communication, cell concept, wireless link, Base station and controller, Mobile switching centre, call authentication, HLR, VLR, Mobile network.
11. Brief history of optical communication.

ELC- 304 Course Outcome (CO):

The course is on the history of Electromagnetic and wireless communication. The course is designed under CBCS. At end of the course students will be able to be:

- Familiar with the history of development of electrostatic, magnetostatic, electromagnetic and electrical telegraphy.
- Acquainted with the history of research on electrical telegraphy.

Practical:

Paper: ELC 395: VLSI Lab **Full Marks: 50** **Credit: 4**

Syllabus:

1. Familiarization with SPICE simulation Model parameter.
2. Using SPICE simulate MOS Inverter with different loads (specifying Cox, μ, VTO, W, L etc of any standard MOS)
3. Using SPICE simulate a CMOS inverter. Obtain the transfer characteristics for different values of β_n/β_p.
4. Obtain the transient response of CMOS Inverter for different values of β_n/β_p.
5. Draw logic circuit using schematic editor.
6. Familiarization of layout tools and design rules.
7. Design layout of a two input CMOS NAND and CMOS NOR gate using layout tool.
8. Introduction of FPGA, Implementation of logic gates using FPGA.
9. Introduction of VHDL/VARILOG programming.

ELC-395 Course Outcome (CO):

- Acquire fundamental knowledge of VLSI circuit design and implementation using circuit simulators and layout editors.
- Familiar with SPICE simulation model parameter.

- Acquire knowledge to obtain characteristics of MOS inverters with different loads using SPICE simulator and transient and transfer response of CMOS inverter.

- Learn to implement any digital logic circuits using schematic editors.

- Able to design the layout of CMOS NAND/NOR gate using layout design tool.

- Learn to implement logic gates using FPGA.

- Able to write VHDL/VARILOG programming.

Paper: ELC 396: Communication Laboratory (Practical)

Full Marks: 50 Credit: 4

Syllabus:

1. Generation and characteristic studies of Amplitude Modulation (AM) and Demodulation Techniques.
2. Generation and characteristic studies of Amplitude DSBSC and Demodulation Techniques.
3. Generation and characteristic studies of SSBSC and Demodulation Techniques.
4. Generation and characteristic studies of Frequency Modulation (FM) and Demodulation Techniques.
5. Generation and characteristic study of Pulse Amplitude Modulation (PAM).
6. Generation and characteristic study of Pulse Width Modulation (PWM).

Optical lab

1. Numerical aperture of optical fibre.
2. Frequency response character of LDR.
3. Optical conversion of digital to analog signal.
4. Measurement of dimension of circular aperture by laser.
5. Study of broadening character of a pulse in an optical fibre.

Signal Processing Lab

Using standard simulator:

1. Generate various fundamental discrete time signals.
2. Basic operations on signals (Multiplicaion, Folding, Scaling etc.).
3. Estimate the PSD of a noisy signal.

4. Convolution and correlation of two sequences.
5. Z-transform of various sequences-verification of the properties of z-transform.
6. DFTs/IDFTs using matrix multiplication and also using commands.
7. Verifications of the different algorithms associated with filtering of long data sequences and overlap-add and overlap-save methods.
8. Butterworth filter design with different set of parameters.
9. FIR filter design.

Using either 5416 or 6713 Processor and Xilinx FPGA:

1. Writing and execution of small programs related to arithmetic operations and convolution using Assembly Language of TMS320C 5416/6713 processor, study of MAC instruction.
2. Writing of small programs in VHDL and downloading onto Xilinx FPGA.
3. Mapping of some DSP algorithms onto FPGA.

Course Outcome (CO):

At the end of the course **ELC-396**, students will be able to:

- Generate different modulated and demodulated signals and characterize them for advancement of the communication systems.
- Measure numerical aperture of different optical fibres, dimension of circular aperture.
- Determine pulse broadening in an optical fibre.
- Perform different experiments using optoelectronic devices (LDR, LASER) for better results in communication.

Semester- IV

Theory:

Paper: ELC 401: Microwave and Power Electronics **Full Marks: 50** **Credit: 4**

(University Written Examination-40 Marks & Internal Assessment- 10 Marks)

Syllabus:

1. **Cavity Resonators:** Basic microwave concepts, Microwave and millimetre wave frequencies, General approach to microwave circuit analysis. S parameter, Microwave Cavities, Rectangular, Circular and Semicircular Cavity resonators, Q-factor,
2. **Microwave Passive Circuits:** Scattering matrix representation of microwave components , Attenuators and directional couples, Power divider, Isolator, Microwave hybrid circuits, Wave guide tees (E-plane, H-plane, Magic tees and their S-matrix calculation), hybrid rings, Wave guide Corners, bends and twists, Wave guide matching components, inductive, Capacitive and Resonant windows, Screw, Posts etc.,
3. **Microwave sources (Vacuum Tube):** Microwave linear beam tubes, Klystrons, Reflex klystron, TWT, Microwave crossed field tubes: Magnetron.
4. **Microwave Solid state Sources-1:** Microwave bipolar junction transistor, hetrojunction bipolar junction transistor. Tunnel diode,
5. **Microwave Solid state Sources-2:** Transferred electron devices, Gunn diode, limited space charge accumulation diode, Avalanche diode, IMPATT diode, TRAPATT diode.
6. **Power Devices:** Characteristics of solid state power devices, SCR, UJT, DIAC and TRIAC, Thyristor. Triggering Circuits,
7. **Power Circuits:** Converter, chopper, Inverters, AC regulators, Speed control of AC and DC motors. Three phase controlled rectifier, Switch mode power supply, uninterrupted power supply.

ELC- 401 Course Outcome (CO):

This paper contains Microwave Engineering and Power Electronics separately. In microwave engineering cavity resonators, microwave networks, sources of microwave are in the syllabus. Students at the end of the course will be able:

- To learn microwave engineering.

- Acquire knowledge on power electronics with the power devices like Thyristor, SCR, UJT, DIAC, TRIAC, AC and DC motors, phase controlled rectifier etc.

Paper: ELC 402: Microprocessor and its Applications **Full Marks: 50 Credit: 4**

(University Written Examination-40 Marks & Internal Assessment- 10 Marks)

Syllabus:

1. **Introduction to 8085 microprocessor:** Computer, Microprocessor and Microcomputer, Microprocessor application, 8085 µP architecture and its operation, Memory, Input and Output(I/O), Peripheral mapped and Memory – mapped I/O, addressing modes and Timing diagrams (for a few instruction), Data transfer between memory, 8085 µP and I/O.
2. **Programming with 8085:** Assembly language programming for one specific processor(say8085 µP), Arithmetic and logical processing, Branching and Stack related instructions, Time delay loop, Procedures, Data tables, Macro-modulator programming, Hard and Software integration.
3. **Interrupts:** Interrupts for 8085 µP, Basic interfacing concepts, Memory – mapped and I/O mapped interfacing.
4. **Interfacing:** 8255 programmable peripheral interface, 8259 programmable interrupt controller, 8251 USART, Serial and parallel data transfer, ADC and DAC to interrupts, Interrupt circuits, keyboard and display interface. Current loop interface, RS 232 serial interface standard, IEEE 488 standard, Error detection and correction.
5. **Microcontroller:** 8051 microcontroller systems, introduction to RISC processor, ARM microcontroller.
6. **Introduction to 8086 microprocessor:** Overview of 8086/8088 µP architecture.

Course Outcome (CO):

The course **ELC-402** is designed to give in-depth understanding of operation of microprocessors and microcontrollers. On the successful completion of this students will:

- Have the knowledge about architecture of microprocessors and microcontrollers.
- Able to write programs for microprocessors and microcontrollers.
- Acquire knowledge to interface peripheral devices with microprocessors and microcontrollers.

- Be competent to formulate appropriate solution for microprocessors and microcontrollers based systems.

Paper: ELC 403: Control system & Instrumentation **Full Marks: 50 Credit: 4**

(University Written Examination-40 Marks & Internal Assessment- 10 Marks)

Syllabus:

1. **Introduction:** Concepts of Control Systems- Open Loop and closed loop control systems and their differences- Types of feedback control system.
2. **Transfer Function Representation:** Transfer Function of linear systems, Block diagram Reduction method, Signal flow graph, Mason's gain formula.
3. **Time Response Analysis:** Standard test signals - Time response of first order systems, Characteristic Equation of Feedback control systems, Transient response of second order systems, Time domain specifications – Steady state response - Steady state errors and error constants. P, PI and PID Controllers, Tachometer.
4. **Stability Analysis:** The concept of stability – Routh's stability criterion, Root Locus Technique: The root locus concept.
5. **Frequency Response Analysis:** Bode diagram, Phase margin and Gain margin, Stability Analysis from Bode Plots. Polar Plots, Nyquist Plot Stability analysis.
6. **Transducers:** Resistance, inductance, capacitance, piezoelectric, thermoelectric and Photoelectric transducer, Hall effect measurement, Measurement of displacement, velocity, acceleration, force, torque, strain, temperature, pressure, flow, humidity, thickness, pH and position.
7. **Measuring equipments:** Measurements of R, L and C. Digital Storage Oscilloscopes, Logic state analyzer, Signal generators, Distortion analyzer, Spectrum analyzer, Instrumentation amplifiers, and Radio telemetry.
8. **Analytical Instrument:** Spectrophotometers, Electron microscope.
9. **Biomedical instruments:** ECG, blood pressure measurements.

ELC 403 Course Outcome (CO):

- Able to categorize different types of system and represent a complex control system model into a more simplified form by using block diagram reduction method, signal flow graph, Mason's gain formula.

- Learn to identify any control system in Laplace domain to illustrate different parameter of the system using transfer function concept.

- Acquire knowledge to employ time domain analysis for transient analysis of the system for various standard input functions.

- Understand the stability of a control system using Routh's stability criterion, Root Locus technique, Bode plot and Nyquist plot.

- Acquire basic concept and definitions of measurements.

- Acquire knowledge on working of various measuring equipment like digital storage oscilloscopes, logic state analyzer, signal generators, distortion analyzer, spectrum analyzer, instrumentation amplifiers, and radio telemetry.

- Obtain knowledge about analytical instruments and biomedical instruments like spectrophotometers, Electron Microscope ECG and blood pressure measurements.

Paper: ELC 404: Optical Communication and Information Processing

Full Marks: 50 Credit: 4

(University Written Examination-40 Marks & Internal Assessment- 10 Marks)

Syllabus:

1. **Perturbation theory:** Time independent and time dependent, Fermi's Golden rule for transitions.
2. **Modal analysis:** Application of optical fiber in communication and its Advantages, Basic principles of light propagation, Optical fibers - modal propagation-Ray Model, Wave Model , Quantum Model.
3. **Losses in optical communication:** Attenuation in optical fiber, Signal distortion on optical Fibers-Dispersion-Material, Intermodal and Intramodal, Attenuation-Material, Loss Mechanism in Optical Fibers-Absorption and Scattering, Fresnel Reflection, Micro bending & Macro bending radiation, Connector types and Splices, Misalignment and Mismatch losses, The optical Directional Coupler.
4. **Optical sources:** LEDs: Direct band gap semiconductors, Spontaneous emission, LED structures, Internal quantum efficiency, Linearity, Radiation pattern and spectra, Modulation characteristics, Transient response; Lasers: Stimulated emission and lasing, Laser structures, Radiation pattern and spectra, Narrow-line width lasers, Modulation characteristics: Threshold current and its temperature sensitivity, Turn-on delay, Linearity; Gas Laser, Semiconductor laser.

5. **Coding:** Pulse coding principle, Multiplexing and de-multiplexing of signal: Time Division Multiplexing and De-multiplexing, Wavelength Division Multiplexing and De-multiplexing,
6. **Optical receiver:** Photo receivers, Photoconductors, Semiconductor Photodiodes, Photo Transistors, noise. Optical link design, power penalty. SONET/SDH, DWDM, optical switches, Fiber Amplifiers, EDFA, DRA, WDM networks and components and Optical CDAMA.
7. **Parallel Optical Computation and data processing:** Digital optics, Optical logic gates, Half-adder, Full-adder
8. **Communication**: Communication with laser as source (Channel based and channel less), LlDAR.
9. **Non-linear Optics:** Non-linearity of medium, second and higher harmonic generation, phase matching condition, frequency addition and frequency subtraction.

Course Outcome (CO):

At the end of the course **ELC- 404**, it will be developed in the students:

- The concept of perturbation theory and its use to solve different problems in science and technology.
- Clear understanding on various components of entire communication system in detail.
- Understanding of optical networking, optical computation and data processing.
- Basic knowledge of non-linear optics.

Practical:

Paper: ELC 495: Microprocessor Programming Laboratory (Practical)

Full Marks: 50 Credit: 4

Syllabus:

1. Assembly language/machine language programming of 8085/8086 µP based on arithmetic and logical processing, time delay loop etc.
2. Memory interface with 8085/8086 CPU using IC 8255A.
3. Test and program the peripheral IC 8255A in different modes using 8085 µP.
4. Interface 8255/8259/8279/with 8085/8086 microprocessor.
5. ADC interface with 8085/8086 µP.
6. Keyboard and display interfaces with 8085/8086 µP.
7. Interface a stepper motor with 8085/8086 µP.
8. Experiments with open source microcontroller “Arduino”

Course Outcome (CO):

Microprocessor Programming Laboratory trains the students to work in practical field of microprocessors and microcontrollers. At the end of the course **ELC-495** students will be:

- Able to write assembly language program of microprocessors and microcontrollers.
- Successful to acquire skills to interface peripheral devices with microprocessors and microcontrollers.
- Confident to analyze a problem and give proper solution for microprocessors and microcontrollers based applications.

Paper: ELC 496: Project Work/Industrial Training Full Marks: 50 Credit: 4

The project work may be carried out on research problem. It may be performed in and outside the department. Students may carry out industrial training also and should submit report to the department during examination.

(Examination)

The project report/Industrial training report will be examined by presentation and viva-voice in the presence of external examiners. Department should organize such examination for presentation and viva-voice.

Course Outcome (CO):

Project work/Industrial training (Course: **ELC-496**) is an important part in the syllabus to grow a student strong enough to sustain in the real world. At the end of the programme students will be:

- Fit for higher studies, research work and industrial work.
- Able to develop an entrepreneurship program.
- Courageous to participate in the nation building programs like Start up business, Make in India. .

BOOKS RECOMMENDED

1. Mathematical methods for Physicists, G. Arfken.
2. Introduction to Mathematical Physics, Harper.
3. Mathematical Method (2nd et), Potter.
4. Advanced Engineering Mathematics, M.D: Greenberg.
5. Complex Variables and Applications, R V Churchill.
6. Theory and problems on Laplace Transforms, Spiegel.
7. Numerical Analysis, Scarbarroh.
8. Optics, Ajoy Ghatak.
9. Quantum Mechanics, Agarwal and Hariprakash.
10. Quantum Mechanics, S.N. Ghoshal.
11. Quantum Mechanics, Ghatak and Loknathan.
12. Quantum Mechanics, Schiff.
13. Problems in Elementary Quantum Mechanics, S. Bala Subranium.
14. Solid State Physics, D.L. Bhattacharya.
15. Introduction to Solid State Physics, Kittel.
16. Solid state physics, Dekker.
17. Electrical Engineering Material, Dekker.
18. Solid State Electronic Devices, Streetman.
19. Solid State Electronic Engineering Materials, S.O. Pillai.
20. Microeletronic Circuits and Devices, Horenstein.
21. Microelectronic Circuits, AS. Sedra and KC. Smith.
22. Microelectronics, Millman and Taub.
23. Circuit theory, Chattopadhay and Rakshit
24. Network analysis, Van Valkenberg.
25. Electronic circuit analysis and design, Hyat and Neudeck.
26. Basic Circuit Theory, L.P Huelsman
27. Electronic Devices and Circuit Theory, Boylested and Nashelaky.

28. Electronic Devices and Circuits, Mottershed.
29. Integrated Electronics, Millman and Halkias.
30. Electronics Principles, Malvino.
31. Electronics Fundamental and Application, Chattopadhyay and Rakshit
32. Application and Design of Analog Integrated Circuits, Jacob.
33. Operational Amplifiers and Linear Integrated Circuits, Coughing and Discolt
34. OP-AMPS Linear Integrated Circuits, Gaykwad.
35. Introduction to Electodynamics, Griffith.
36. Electromagnetic Waves & Radiating Systems, Jordan and Baihnan.
37. Microwave propagation and technique, D.C. Sarkar
38. Microwave Device and Circuits, Liao.
39. Elements of Engineering Electrodynamics, M.M. Rao.
40. Networks, Lines and Fields, Ryder.
41. Laser, Ghatak and Thyagarajan.
42. Optical Electonics, Ghatak and Thyagarajan.
43. Semiconductor Opto-electronics, Pallab Bhattacharya.
44. An introduction to opto-electronics, Wilson and Hawkes.
45. Laser Electronics, Vereyan.
46. Digital computer Design, M. Mano.
47. Fundamentals of Computers, Rajaraman.
48. Introduction to Digital Computer Design, Rajaraman and Radhakrishnan.
49. Algorithms +Data Structures = Programs, Writ.
50. Computer Networks, Tanenbanm.
51. Computer Networks : Protocols, Standards and Interfaces, Black
52. Local Area Network and their applications, Tangney and Omahony.
53. IBM PC/XI: Basic programming and Applications, Boylestad and Nashelsky.
54. Digital Electronics, Gothmann. .
55. Digital Principles and Applications, Malvino and Leach.

56. Digital Electronics, Malvino.
57. Digital Computer Electronics, Malvino and Brown.
58. Digital Systems: Principales and practices, Tocci.
59. "8000 to 8085 Introduction to Microprocessor for Engineers, and Scientists", Ghosh and Sridhar.
60. Microprocessor Architecture, Programming, and Applications with the 8085, Gaonkar.
61. Labortory Manual: experiments on, microprocessor, AK. Mukhopadhyay.
62. Communication Systems, Kennedy.
63. Communication Systems, B. Carlson.
64. Principle of Communication Systems, D. Schilling and H. Taub.
65. Signal Processing and Linear Systems: B.P.Lathi.
66. Communication Systems: B.P.Lathi.
67. Analog and Digital Communications, Roden.
68. Electronic communication, Roddy and Coolen.
69. Modern Electronic Instrumentation and Measurement Techniques, Helfrick and Cooper.
70. Modem principles of Measurements and Instrumentation, Morris.
71. Transducer and Instrumentation, Murthy.
72. Electronic Measurements, Terman and Peti.
73. Semiconductor Devices: S.M.Sze.
74. Digital Signal Processing: Principles, algorithms and applications,J.G. Proakias & D.G.Manolakis, PHI
75. Digital Signal processing: Hands on approach, C. Schuler and M. Chugani, TMH
76. Discrete Time Signal Processing, A.V. Oppenheim and R.W. Schaffer, PHI
77. Theory and applications of Digital Signal Processing, L.R. Rabiner and B. Gold, Prentice Hall.
78. Fiber optics and Optoelectronics, R.P. Khare, Oxford Press
79. Optical Fiber Communication Principles and Systems, A. Selvarajan, S.Kar and T.Srinivas, TMH
80. Optical Fiber Communications, Keiser, G. McGraw Hill, Int. Student Ed.
81. Fiber Optic Communication systems, G.P.Aggarwal,Wiley Eastern

82. Introduction to Fiber Optics , A.Ghatak and K.Thyagrajan, Cambridge Univ. Press

83. Introduction to Optical Electronics, K.A. Jones, Harper & Row

84. Principles and Applications of Optical communications, M.K.Liu, McGraw Hill

85. Power Electronics ‘,’ N.Mohan, J.M. Undeland, and W.P. Robbins, John Wilay and Sons, 2003-2004.

86. Power Electronics, M.D. Singh,K.B.Khanchandani, Tata McGrawHill Publishing Co

87. VLSI Fabrication Principles, S.K. Gandhi, John Willey & Sons.

88. VLSI Technology, S.M. Sze, McGraw Hill,Int. Book Company.

89. Modern VLSI Design, W.Woulf, Pearson

90. Principles of CMOS VLSI Design, N. H.E. West and K.Eshranghian, PHI

91. Basic VLSI Design , D.A. Pucknell K. Eshraghian, PHI.

92. Digital Integrated Circuit Design, K. Martin, Oxford

93. Introduction to VLSI Systems, Mead C & Conway L.Addison Wesley Pub.

94. Analysis & Design of Digital Integrated Circuits, Hodges & Jackson,McGraw Hill Int. Pub.

95. Integrated Circuit Engineering, Glasser, A.B Sharpe, S McGraw Hill Int. Pub.

96. Large Scale Integration, Howes M.G.Morgan D.V,J. Wiley.

97. Digital Signal Processing: Principles, algorithms and applications,J.G.Proakias & D.G. Manolakis, PHI

98. Digital Signal processing: Hands on approach, C. Schuler and M. Chugani, TMH

99. Discrete Time Signal Processing, A.V. Oppenheim and R.W. Schaffer, PHI

100. Theory and applications of Digital Signal Processing, L.R. Rabiner and B. Gold, Prentice Hall.

101. CMOS VLSI Design, N.H.E. Weste, K. Eshranghian, Addison Wesley

102. Digital Design Principles, J. Wakerley,Prentice Hall of India.

103. Digital Sytems testing and testable design, MIron Abromovici, Melvin Breuer, Arthur Freedman, Jaico Publishing House

104. VHDL, D. Perry,McGraw Hill Int. Edition.

105. Computer Data Communication, Williams

106. Computer Networking, Tannunbam, PHI

107. Electronic Properties of materials, R.E. Hummel

108. Electronic Properties of materials, David Jiles

109. Solid State Physics, Dekkar

110. Introduction to Solid State Physics, C.Kittle

111. Solid State Physics, Ashcroft, Mermin

112. Principles of Electronic materials & dev, S.O. Kasap