WEST BENGAL STATE UNIVERSITY

BARASAT, 24 PARGANAS (N)

B. Sc. in Electronics (Honours) (1+1+1) Years Syllabus

Syllabus for three-year B.Sc. Honours Course
Detailed Syllabus

Distribution of Papers, Marks and Lectures/Periods

Part-I F.M: 200

Paper	Modules	Marks distribution	Full marks	Lectures/ periods
Paper I - ELTA 122 101	1. Mathematical & Numerical Methods: Theory	50	100	50
	2. Circuit Theory: Theory	25		25
	3. Heat & Thermodynamics: Theory	25		25
Paper II - ELTA 122 102	1. Statistical Mechanics: Theory	25	100	25
	2. Quantum Mechanics: Theory	25		25
	3. Electricity and PSPICE: Practical	50(40+10)		

Part-II F.M: 200

Paper	Modules	Marks distribution	Full marks	Lectures/ periods
Paper III - ELTA 122 201	1. Computational Methods: Theory	20	100	20
	2. Solid State Physics: Theory	30		30
	3. Solid State Devices and Circuits: Practical	50		
Paper IV - ELTA 122 202	1. Active Devices: Theory	25	100	25
	2. Active Circuits: Theory	40		40
	3. Electronics Instrumentation: Theory	35		35

Part-III F.M: 400

Paper	Modules	Marks distribution	Full marks	Lectures/ periods
Paper V - ELTA 122 301	1. Electromagnetic Fields and Waves: Theory	50	100	50
	2. Microwave Electronics and Photonics: Theory	50		50
Paper VI - ELTA 122 302	1. Digital Electronics: Theory	40	100	40
	2. Microprocessors: Theory	20		20
	3. Communication: Theory	25		25
	4. Computer Science: Theory	15		15
Paper VII - ELTA 122 303	1. Linear Integrated Circuits and Communication Systems: Practical	60	100	
	2. Assembly Language Programming on the 8085 Microprocessor: Practical	40		
Paper VIII - ELTA 122 304	1. Digital Electronics: Practical	60	100	
	2.Computer Programming in C-Language: Practical	40		

Paper I - ELTA 122 101

Module 1: Mathematical & Numerical Methods:

Vector analysis: Definition and classification of vectors, Scalar and vector products, Vector calculus-application to simple problems. Theorems-Gauss' divergence, Stokes, Green's with simple applications.

Matrix: Addition, subtraction, multiplication, non-commutativity, Hermitian and unitary matrices, digitalization, eigen values and eigen vectors for real symmetric matrix, quadratic forms.

Differential Equations: First and second order differential equations, equations with constant coefficients (homogeneous and inhomogeneous).
Second order linear differential equation with variable coefficients, outlines of Frobenious method of power series solution, illustration by special functions (Hermite, Bessel, Legendre polynomials, beta and gamma functions)
Partial differential equation and its solution in different co-ordinate systems, wave equation and its solution.

Fourier's Series: Definition of linear independence and completeness of set of functions. Fourier's theorem (proof not required), equations involving Fourier's coefficients, analysis of simple waveforms using Fourier series, Fourier integral.

Laplace transform: Properties and simple problems.

Numerical Method: Solution of algebraic and transcendental equations by bisection method, Newton-Raphson method. Numerical differentiation. Numerical integration: Simpson's 1/3 rule, Gauss's quadrature. Solution of ordinary linear differential equations: Euler's method, Runge Kutta method.

Module 2: Circuit Theory

Loop and nodal Analysis: Kirchoff's current and voltage laws, examples of loop and nodal analysis. Network theorems: superposition, reciprocity, Thevenin's, Norton's theorem, maximum power transfer theorem, bisection, Millman theorem T-pi and to pi-T transformation.

Wave shaping circuits: Frequency response of R-C networks-passive filter, integrator, differentiator, phase lead-lag circuit, passive filter (first order only).

Transients: Use of Laplace transforms- theorems and application in transient analysis of different electrical circuits with and without initial conditions. Growth and decay of current in LR circuit, Charging and discharging of capacitors in CR and LCR circuits, Oscillatory discharge, time-constant.

Network Topology: graph of network concept of tree branch, tree link. Incidence matrix, Tie-set matrix and loop currents, cut set matrix and node pair potentials. Two-port networks-open circuit impedance and short circuit admittance parameters and their interrelations.

Alternating current: LR, CR and LCR circuits. Power factor, series and parallel resonant circuits, Q-factor, selectivity. Magnetically coupled circuits-Mutual inductance, linear transformer, ideal transformer, T and Pi equivalent circuits.

A.C. Bridges: Generalized Wheat- stone bridge, Anderson's Bridge, Maxwell's.

Module 3: Heat & Thermodynamics

Kinetic theory of gases: Evidence of molecular motion, association of heat with molecular motion. Basic assumptions of the kinetic theory of gases. Derivation of Maxwell's law of distribution of molecular speeds from probabilistic approach, average velocity, RMS velocity and most probable velocity. Boltzmann's extension of Maxwell's law. Temperature dependence of velocity distribution.

Degrees of freedom of molecules: Law of equipartition of energy, Application of the law to calculate specific heats of gases. Values of Cp and Cv and their ratios for monatomic, diatomic and polyatomic gases. Dulong and petit's law. Limitation of the kinetic theory of specific heat.

Free path: Probability of a free path x, mean free path. Distribution of mean free path. Expression for mean free path ignoring the effect of the distribution of molecular speeds.

Scope of thermodynamics, Microscopic and Macroscopic point of view: State variables, thermodynamic equilibrium. Zeroeth law of thermodynamics. Intensive and extensive properties of a thermodynamic system.

External & internal work: Quasi-static process, work done in quasistatic isothermal expansion or compression of an ideal gas. Work and heat, adiabatic and non-adiabatic work, internal energy function. Mathematical formulation and differential forms of the first law of thermodynamics. Heat capacity and molar heat capacity. Definitions of Cp and Cv for an ideal gas. Work done in a quasi-static adiabatic process.

Laws of Thermodynamics: Efficiency of Carnot's cycle, Kelvin-Planck and Clausius statement of the second law of thermodynamics. Equivalence of Kelvin-Plank and

Clausius statements. Carnot's theorem. Reversible and irreversible processes. Conditions for reversibility.

Concept of entropy: Entropy and the mathematical formulation of the second law. T-S diagram. Entropy change in an irreversible process. Principle of increase of entropy. Entropy and unavailable energy(statement only). Probabilistic interpretation of entropy (statement). Entropy and disorder. Absolute entropy. Entropy and information (Basic ideas).

Thermodynamic potentials: Helmholtz free energy, enthalpy function,Gibb's free energy, chemical potential. Relation of chemical potential with Fermi level. Maxwell thermodynamic relations.

Reference Books:

1. Advance Engineering mathematics by Kreyszig - John Wiley.
2. Higher Engineering Mathematics by B.S.Grewal - Khanna.
3. Mathematical methods for physicists by Weber & Arfken - Elsevier.
4. Vector Analysis by Spiegel -TMH.
5. Numerical methods by Balaguruswami - TMH.
6. Numerical methods by Mathews – Pearson.
7. Network Analysis by van valkenburg – Pearson
8. Circuit theory by A. Chakraborty – Dhanpat Rai.
9. Engineering citcuir Analysis by Hayl – TMH.
10. Network Analysis by S.Sudhakar – TMH.
11. Circuit theory by Chattopadhayay- Rakshit – New Age.
12. Electrical Technology & circuit theory by B.L.Thereja -.
13. Introduction to PSPICE by Rasid – Pearson.
14. Heat & Thermodynamics by Zemansky & Dittman – MC Grow Hill.
15. Thermal Physics by Roy & Gupta – centsal.
16. Introduction to Quantum Mechanics by Griffiths –Pearson.
17. Classical Mechanics by Goldstein – Pearson.

18. Statistical Mechanics by Pathria – Elsevier.

Paper II - ELTA 122 102

Module 1: Statistical Mechanics:

Macroscopic and Microscopic States: Phase space and phase trajectory. The μ-space and the Γ- space. Postulate of equal-a-priori probability. Ensembles. Time average and ensemble average. Density distribution in phase space, Condition for statistical equilibrium. Micro canonical ensemble (concept only). Statistical interpretation of entropy.

Quantum Statistics: Quantization of phase space. Indistinguishability of identical particles. Symmetry of wave function and its relation with spin. Boson and fermions. Effect of symmetry on counting. Examples illustrating counting procedures for MB, BE and FD statistics. Derivation of distribution functions for the three statistics using micro canonical ensemble. Conditions under which the quantum mechanical distribution functions reduce to the classical MB distribution. Comparison between the three statistics.

Bose-Einstein Statistics and Blackbody radiation: Applicability of the results of thermodynamics to the radiant energy within an enclosure. Cavity radiation as a photon gas. Density of states for photons. Derivation of Plank's law by applying BE statistics to a photon gas. Energy density as a function of λ &ν. Rayleigh-Jeans formula for low frequencies and Wien's formula for high frequencies. The total radiant energy density: Stefan-Boltzmann law, Stefan's constant. The specific heat at constant volume. Entropy of a photon gas.

Module 2: Quantum Mechanics:

Photoelectric phenomenon: Failure of the classical theory. Einstein's photoelectric equation, concept of photon. Compton effect, derivation, Compton shift and simple problems.

Dual nature of radiation: Postulate of de-Broglie on the wave nature of matter. De Broglie's wavelength for non-relativistic and relativistic particles. Phase and group velocity. Wave-particle duality and the principle of complementarity. Representation of de Broglie wave by a wave function $\psi(x, t)$, wave packet. Heisenberg's uncertainty principle. Necessity of probabilistic description in quantum theory.

Basic Postulates of Quantum Mechanics: Specifications of the state of a quantum mechanical system by a wavefunction. Requisite properties of admissible wavefunctions.

Normalizability, observables, probability density, Operators associated with Position, momentum and kinetic energy. Hamiltonian, angular momentum in Cartesian coordinates. Commutation relation between operators. Simple properties of Hermitian operators. Representation of observables by Hermitian operators. Eigen values and Eigen functions of Hermitian operators. Expectation value of the measurement of a dynamical observable.

Time-dependent Schrödinger equation: In one dimension and in three dimensions. Wave function description of an electron in free space, Schrödinger equation as an operator equation. Physical interpretation of ψ , probability current density. Time-independent Schrödinger equation. Stationary states.

Application of Schrödinger equation: (a) Free particle moving in one dimension, (b) particle in a one-dimentional infinite potential well, (c) The potential step, (d) The rectangular potential barrier. Linear harmonic oscillator, the hydrogen atom problem, Qualitative treatment.

Reference Books

1. Statistical Mechanics by Laud – New age International.
2. Statistical Mechanics by Pathria – Elsevier.
3. Thermal & Statistical Physics by Reif – McGrowhill
4. Thermodynamics kinetic theory and statistical mechanics by sears & salinger – Narosa
5. Statistical Mechanics by Huang – TMH
6. Introductory quantum mechanics by S.N.Ghosal –
7. Introduction to quantum mechanics by Griffith – Pearson.
8. Quantum Physics by Eisberg & Reisnick – John-wiley.
9. Quantum physics of atoms & molecules by Eisberg & Reisnick – John-wiley.
10. Quantum mechanics by Powell & creshmann – TMH.

Module 3: Electricity and PSPICE: Practical

Electrical part 40
Pspice: 10

1) Experiments on Electricity:
    (a) Verification of
        (i) Thevenin's theorem

(ii) Norton's theorem
(iii) Maximum power transfer theorem using a resistive Wheatstone bridge, dc meters.

(b) Measurement of self-inductance of a coil and measurement of mutual inductance between two coils by Anderson bridge.

(c) Investigation of inductance in ac circuits:

(i) To verify the current-voltage characteristics for an inductance in ac circuit and hence to measure the value of inductance.

(ii) To determine the phase-difference between the current and voltage in a series LR circuit at different frequencies.

(iii) To study the variation of the reactance of the inductive coil with frequency of the ac source and hence to measure its inductance.

(iv) To find the value of the loss-angle δ, the resistance of the inductor R and the inductance of the inductor L, from the phasor-diagram.

(2) Investigation of capacitance in an altering current circuit:

(i) To verify the current- voltage relationship for a capacitor in an ac circuit being linear and hence to measure the value of the capacitance

(ii) To determine the phase-difference between the current and the voltage in a series CR circuit at different frequencies.

(iii) To study the variation of the reactance of a capacitor with frequency of the ac source and hence to measure the capacitance.

(iv) To find the value of the loss-factor and loss-angle δ of a capacitor from the phasor-diagram.

(3) To draw the resonance curve of a series LCR circuit for different values of R and L/C and hence to determine the Q-factor in each case.

(4) To find the Q-factor from the ratio Vc / Vi at resonance.

(5) To draw the phasor-diagram of voltages ate series resonance.

(6) To observe waveforms and to measure amplitude, frequency and phase with a CRO using a simple RC network.

(7) To study the frequency responses of a low-pass and high-pass RC-network. Also to study the RC-circuit response to sine and square inputs.

(8) To dertermine the Fourier spectrum of square and triangular waveform by using a parallel resonant circuit and CRO.

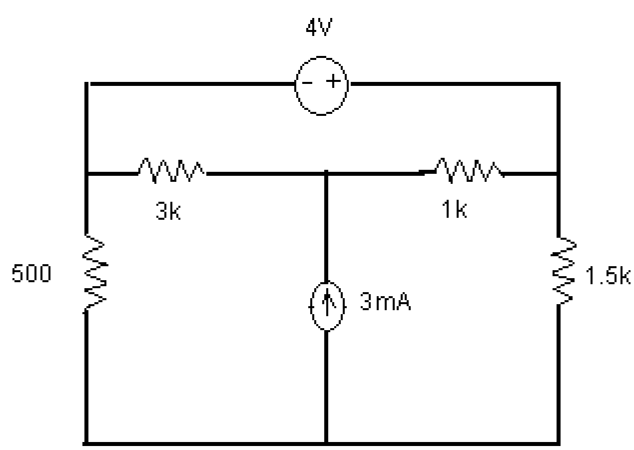
(9) *Experiments on Pspise*.

(a) CIRCUIT ANALYSIS USING SPISE/PSPICE
DC analysis: Independent souces
Use of data statements for passive elements.
Use of data statements for independent current and voltage souces.

Some of the example programs are given below

Example Program:

1. Write the Spice/Pspice source program for the following circuit, run PSpice for DC analysis and obtain the output on screen.

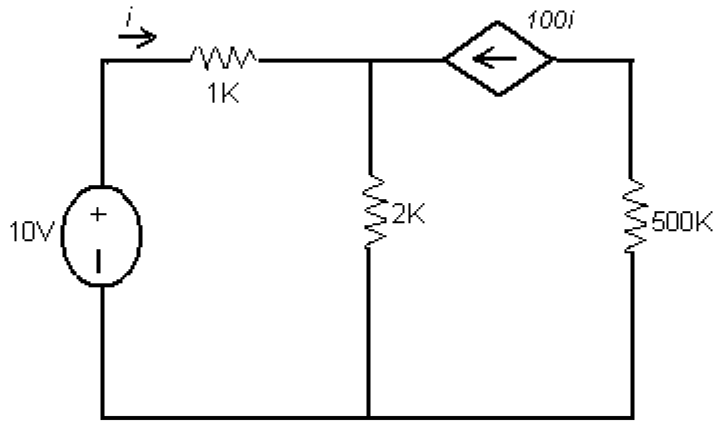


The values of the passive components and sources are for indicative purposes and may be varied

DC Analysis: Dependent sources
Use of data statements for dependent sources '
Voltage-controlled voltage source (VCVS)
Voltage-controlled current source (VCCS)
Current-controlled voltage source (CCVS)
Current-controlled current source (CCCS)

Example Program:

2. Write the Spice/PSpice source program for the following circuit, run PSpice for DC analysis and obtain the output on screen.



The values of the passive components and sources are for indicative purposes and may be varied.

Use of control and output statements in DC analysis
(.OP, .DC, .PRINT, .PLOT and .PROBE)

References:

1. Practical Physics – Rakshit and Chattopadhyay.
2. Advanced Practical Physics – B.Ghose (Vol II)
3. Laboratory manual for electric circuit
4. Introduction to PSPICE – D. Bell (PHI) – Rasid (Pearson).

Paper III - ELTA 122 201

Module 1.Computational Methods: Theory

Basics of C language: Loops ,arrays, functions, structures, pointers. Implementation of the different numerical methods (Newton Raphson method, Numerical differentiation, Numerical integration : simpson's 1/3 rule. Solution of ordinary linear differential equations: Euler's method, Runge Kutta method.) using C programming.

Reference Books:

Numerical Methods, Balaguruswamy –TMH
Numerical Methods, Mathews –Pearson
Programming in C by Gottfried – TMH

Module 2. Solid state Physics: Theory

Crystal Physics: Crystalline and amorphous solids, primitive and unit cells, Bravais lattices, crystal structure, lattice and basis. Lattice translation operation. Translation symmetry. Elementary idea of point symmetry operations (inversion centre, rotation and reflection symmetry).primitive translation vectors, Miller indices for designating crystal planes. Reciprocal lattice. Volume of a primitive cell in the reciprocal space.

X-ray diffraction as a tool for studying crystal structure. Condition for Bragg- reflection. Geometrical interpretation of the Bragg equation in the reciprocal space.

The free electron theory: Free electron gas in one and three dimentions. Thermionic emission , work function , electrical conductivity of the free electron gas: Drude Lorentz Model, Sommerfield's quantum theory .the heat-capacity of the conduction electrons (Electron Specific heat). The Fermi surface and its effects on the electrical conductivity. Thermal conductivity in metals. Widemann-Franz law and its validity. Hall effect . Failure of the free electron model.

Energy band in solids: Origin of energy bands in solids, classification of solids as metals , insulators and semiconductors on the basis of the band picture, Origin of the energy gap (qualitative discussions). Bloch's theorem in one dimension (proof not required), the Kronig-Penney model (detailed calculations not required.). E-K diagram , Reduced zone representation ,Brillouin zone ,concept of effective mass and holes, Density of states for electrons in band.

Physics of Semiconductors: Intrinsic , extrinsic , degenerate ,non degenerate , elemental and compound semiconductors. The band structure of semiconductors, Equilibrium carrier concentration in a nondegenerate semiconductor, law of mass-action, Fermi level in intrinsic semiconductor, statistics of extrinsic semiconductors. General equation for an extrinsic semiconductors, Fermi levels in n-and p- type semiconductor at low temperatures (no detailed calclutions). Electron density of states, Diffussion and drift processes in semiconductor, equation of continuity,

The optical properties of semiconductors(brief qualitative discussion only).Idea of homo and hetero-juntions.

Reference Books:

Elementary solid state physics,M.Ali Omar – Pearson Education

Introduction to solide state Physics, C.Kittel – John Wiley
Solid state Electronic Device, Streetman – Pearson

Module 3. Solid State Devices and Circuits: Practical

1.Study of p-n junction diode:
(a) To study the ripple-factor of half-wave, full-wave and bridge-rectifier with and without filter(the waveform to be studied in a CRO).To study the use of bleeder resistor in a π-type filter.
2.Study of a Zener diode:
(a) To study the reverse bias characteristics of a Zener diode.
(b) To study the load and line regulation of a Zener diode voltage regulator.
3. To study transistors:
(a) To draw the static characteristics of npn transistors in CE configuration and hence to find the hybrid parameters in dc mode from CE configuration.
(b) To study the dc loadline of a CE amplifier and hence to predict amplifier operation from the loadline.
(c) To study the bias stabilization of a CE amplifier with voltage-divider bias and hence to study the effect of C_E on gain.
(d) To construct and study the frequency response of two stage RC coupled amplifier using transistor in CE mode and to find out the bandwidth. To study the linearity of the amplifier.
4.To study FET:
(a) To draw the common-source drain characteristics and the transfer characteristics of a JEET and to determine its transconductance.
5. To construct and study the operational characteristics of a regulated power supply.
6. To learn offset null adjustment of an opamp. To measure the input offset voltage, input bias current, input offset currents of an opamp.
7. To use the opamp as the inverting, non-inverting, differential amplifier, unity gain buffer, and adder.

Reference Books:

1.Basic Electronics: A Text Lab Manual, Zbar –TMH
2.Laboratory Manual for Electronic Devices and Circuits, Bell –PHI
3.Advanced Practical Physics Volume 2,B.Ghosh

Paper IV - ELTA 122 202

Module 1. Active Devices: Theory

Semiconductor diodes: P-N Junction diode, Zener diode, Pin diode, Varacter diode, LED ,Photo diode, Gunn diode, Tunnel diode.

Bipolar junction transistor : The junction transistor ,transistor current components, transistor as an amplifier and switch, input and output characteristics in CB ,CE, CC mode, non-ideal effects in BJT, saturation , cutoff and active region. Charge control model of BJT ,non-ideal effects.

SCR: Structure and working principle.

Field Effect Transistors: Junction field effect transistor(JFET)-basic Structure and characteristics.

Metal-Oxide-Semiconductor FET (MOSFET): Characteristics of MOS capacitor, accumulation, depletion and inversion regions, threshold voltage, role of substrate. Structure of MOSFET,I-V Characteristics, common source , common gate, common drain configuration ,non-ideal effects.

Module 2. Active Circuits: Theory

Diode as a rectifier, Clipper ,Clamper, Voltage doubler and Tripler, Diode as a detector.

Transistor circuits-BJT:

Fixed bias, self-bias (CE), stability factors, Compensation techniques, Q point and load line. hybrid parameter models for transistors, analysis of low frequency amplifier (current , voltage and power gain, input and output resistance),BJT as a switch , high frequency hybrid Pi model of transistors, RC coupled amplifier , Darlington configuration. Frequency response-low and high frequency response, cutoff frequencies , Bode plot , Gain-Bandwidth product, Miller theorem.

Field Effect MOS Transistors Circuits:

Self bias, fixed bias, voltage divider bias, for depletion and enhancement mode, small signal ac equivalent circuit of FET as an amplifier. Use of JEET as an AGC device(concept only),Use of MOSFET as a voltage controlled resistor. MOSFET as an amplifier and a switch.

Simple application of delivering variable power to a load Using SCR.

Tuned amplifier : Frequency selective network, LC circuit signal and double tuned amplifiers, analysis of voltage gain and selectivity,

Power amplifiers : Circuit models for Transistors (voltage, current , transconductance , transresistance) and their interrelationship , class A,B and AB type, direct coupled , Transformer coupled amplifiers, push pull circuits, harmonic distortion, crossover distortion, complementary symmetry amplifiers.

Feedback in amplifiers: General theory of feedback, negative and positive feedback, advantages of positive feedback ,types of negative feedback in transistor amplifiers, current series, voltage series, current shunt amplifiers.

Oscillator circuit : Barkhausen criterion, Hartley, Colpitt , Wien- bridge and phase shift oscillators, crystal oscillator ,frequency stability and stability criterion.

Regulated Power supply : series and shunt regulator, using transistors and IC, SMPS.

Reference Books:

Basic Electronics , Ghatak and De – Pearson
Integrated Electronics , Millman and Halkias –TMH
Electronics Devices and Circuit , Schilling and Belove –TMH
OP-AMP and Liner Integrated Circuits ,Gaykwad – Pearson
OP-AMP and Liner Integrated Circuits, Coughlin and Driscoll- PHI
Electronic Principle ,A .P.Malvino.

Module 3. Electronics Instrumentation: Theory

Operational amplifier : Ideal OPAMP, characteristics , Different stages of OPAMP : Differential amplifier, constant current source, (current mirror etc.) level shifter ,ideal and practical OPAMP ,offset current ,offset voltage, CMRR, frequency response, slew rate, inverting and non-inverting amplifier, Transfer characteristics ,effect of finite loop gain, basic OPAMP application : adder , phase shifter ,scale changer, voltage to current and current to voltage converter, differential amplifiers. Comparator ,Schmitt trigger, multivibrators : astable ,bistable and monostable, OPAMP as a sinusoidal oscillator (Hartley, Wien-bridge and Phase shift), instrumentation amplifier.

Multivibrator : VCO .Comparator, Schmitt trigger ,multivibrators : astable ,bistable and monostable using 555 timer.

Cathode ray oscilloscope : Motion of charged particles in simultaneous electric and magnetic fields (cross & parallel), block diagram of CRO, CRT: construction ,principles of focusing and deflection of electron beam, vertical deflection system, basic elements ,attenuation , vertical amplifier , delay line , horizontal amplifier , CRO probes, trigger circuits ,applications of CRO in measuring voltage , frequency ,phase , different types of CROs , brief ideas on dual-beam ,dual trace and storage oscilloscopes.

Reference Books:

Modern Electronic Instrumentation ,Helfrik and Cooper – Pearson
Element of Electronic Instrumentation and Measurement,Carr-Pearson
Electronic Instrumentation , Kalsi –TMH

Paper V - ELTA 122 301

Module 1. Electromagnetic Fields and Waves: Theory

Maxwell's equations: Generalization of Amper's law, concept of electric displacement, Maxwell's equations in integral and diffrential forms with their derivations, Maxwell's equations in matter in terms of free charges and currents, field discontinuities at boundaries-Boundary conditions, Poynting vectors and poynting theorem, its derivation and simple problems.

Electromagnetic waves in non-conducting and conducting media:

Plane waves in isotropic dielectric media, reflection (through transmission) of plane waves at normal and oblique incidence at(through) the interface between two dielectrics, Snelle's law polarization by reflection, Fresnel's equations, Brewster's angle, electromagnetic waves in conductors, skin depth, reflection of plane waves at a conducting surface, concept of dispersion, phase and group velocity, normal and anomalous dispersion, Cauchy's formula.

Transmission lines: Formulation of transmission lines equations in terms of voltage and current and their solutions, characteristic impedance, propagation constant, concept of lossless and lossy lines, reflection coefficient(definition, formula and simple problems), standing wave and standing-waves ratio(definition, formula, simple problems, derivation not required), line impedance (formula, its derivation and simple problems), line impedance in terms of reflection coefficient or standing-wave ratio.

Wave-guides: Basic concept of a wave guide, advantages over transmission lines, group and phase velocities inside a wave guide, TE and TM modes, qualitative study of rectangular waveguide, concept of and relation between guide-wavelength, cut-off wavelength and free-space wavelength, concept of dominant mode (simple problems), field patterns in transverse and longitudinal cross-sections of a rectangular wave guide in TE_{10} mode.

Antenna: Radiation from elementary dipole, Directivity, Gain and Effective aperture, Resonant and non-resonant antennas, Field pattern Radiation resistance and radiation power, antenna resistance, band width, grounded antenna, effects of antenna heights, linear antenna, antenna arrays, array of arrays.

Module 2. Microwave Electronics and Photonics: Theory

Basic of Microwaves: Microwave domains.

Two-cavity klystron: structure, principle of operation (concept of velocity modulation and bunching of electronsm, applegate diagram, no derivations required).

Reflex-klystron: structure, principle of operation (no derivations needed)

Magnetron: principle of operation (no derivations needed).
Transferred electron mechanism and Gunn diode: (Basic idea and no derivations).
Transit time mechanism and the IMPATT diode: (Basic idea no derivations).
Tunneling and tunnel diode: Principle of operation (no derivations needed).
Interference: Coherent sources, conditions of interference, interference in thin wedge-shaped flim, Newton's ring.
Diffraction: Fresnel and fraunhofer types (qualitative discussions). single slit and double slit diffraction, diffraction grating (qualitative discussion only). Releigh's criterion of limit of resolution. Resolving power of gratings.
Polarization: polarization of light. Brewster's law, Malus law. Bifringence and double refraction. Calcite crystal, optic axis, principlal section. Circularly and elliptically polarized light, retardation plates.
LASER: Absorption, spontaneous emission and stimulated emission process, Einstein's A and B coefficients, population inversion, optical pumping and optical resonator, threshold condition for lasing, Q factor, characteristics of LASERs. Fundamentals of He-Ne and semiconductor laser.
Optical fiber: Structure of optical fiber, Advantage, passage of light through a fiber, Step index fiber Graded index fiber ray presentation in optical fiber, Numerical Aperture, fiber parameters, modes of propagation, signal degradation. Attenuation losses- absorption, Dispersion.

Reference Books:

Engineering electromagnetics by Nathan Ida- Springer
Elements of electromagnetics by Sadiku- Pearson
Introduction to Electrodynamics by Griffith-Pearson
Electromagnetics waves and radiating systems by Jordan and Balmain-Pearson.
Microwave Devices and Circuits by Liao-Pearson
Electromagnetic field theory and transmission lines by Raju-Pearson
Electronic communication by Kennedy and Davies
Optical by Hecht &Zajak-Pearson
Optics by Ghatak-TMH
Optoelectronics by Wilson & Hawkes-PHI.
Antenna-J.D Kraus.

Paper VI - ELTA 122 302

Module 1. Digital Electronics: Theory

Number system and codes: Decimal, binary and hexadecimal system, conversions between these systems, binary, octal and hexadecimal addition and substraction, BCD addition and subst--ruction, signed number represention, addition and substraction using 1's and 2's, 9's and 10's complement method, Gray and Excess-3 codes, BCD to Binary conversion, Binary to Gray conversion and vice-versa, BCD to Gray conversion and vice-versa, ASCII code.

Boolean algebra and Logic Gates: Boolean switching algebra: Theorems of swiychings algebra, Number of switching functions, Functional completeness, canonical forms of switching function: the SOP and POS represention, Minterm and Maxterm and their inter-relationship, Conversions between canonical forms and also between non-cononical and canonical forms.
Simplifition of Boolean expression by Karnaugh map. Formation of Karnaugh map, simplification, Incompletely specified functions (Dont's care), Implementation of combinational logic circuits. Two-level AND- OR, NAND and NOR implementations, Universal properties of

logic gates.
Logic families: Transistor as an inverter, need for totem-pole output, Basic TTL inverter, TTL NAND gate circuit, Improvement over basic TTL gates(LS,ALS), Fan-in, Fan-out, Noise-margin.
Combinational logic circuits: Adder/Subtractor, Half and Full using different logic gates, BCD adder Complement addition/subtraction.
Multiplexer: Design and working of 4 to 1 and 8 to 1 MUX, Equation of MUX, Cascading of MUX to make higher order MUX, Use of a 8 to 1 MUX as a logic function generator using truth-table and implementation table. MUX as a Universal logic module.
Decoder/demultiplexer: Decoder as a minterm generator. design of 2 to 4 and 3 to 8 decoder, Cascading of decoder/demux, BCD to 7 segment decoder/driver.
Encoder and priority encoder: Decimal to BCD encoder, Design of a four input priority encoder.
Parity generator and checker circuits, workings and their inter-relations. Basic comparator, 2 to 4 bit.
Sequential circuits: Synchronous and asynchronous sequential circuits, General model S-R, D, J-K Latches-different modes, characteristis, tables, excitation tables, circuit implementations, commercially available latches, Flipflops-J-K, Master-Slaves J-K, D and T Flipflops, timing diagram, eadge triggering of a J-K flipflop, conversions of one flipflop to another, Switching characteristics of flipflop.
Asynchronous counter: Asynchronous MOD-8 binary ripple counter and 4 bit(MOD-16) UP/DOWN counter asynchronous MOD-N counter.
Synchronous counter: 4-bit binary counter, UP/DOWN Counter, synchronous MOD-N counter, shift register
DAC/ADC conversion: DAC-weighted, R-2R lader, ADC-Counter type and succesive approximation type, digital voltmeter and its characteristic.

Reference Books**:**

1. Digital Circuits: Vol.1 and Vol.2. : D. Roychoudhury (Platinum Publisher)
2. Digital Design: M. Mano
3. Practical Digital Design with IC’s: Greenfield
4. Digital Integrated Electronics: H. Taub and D. Schilling
5. Digital System Design: Gajeski
6. Digital Systems: Principles and applications: Tocci

Module 2. MICROPROCESSOR: Theory

Introduction to Microprocesser: 8085A CPU architecture and organition, addressing modes, instruction cycle, machine cycle, timing diagram, instruction set, assembly language programming-simple appilication, use of subroutines and stacks, interrupts- maskable and non masksble.
Address/data bus demultiplexings, generation of control signals(IOR/IOW/MEMR/MEMW). Interfacing memory and peripheral chips (I/O mapped and memory mapped I/O), Peripheral chips- 8255(modes of operation)- keyboard and display interfacing using 8255.

Reference Books**:**

1. Microprocessor Architecture, Programming & Application-R. Gaonkar, Wiley
2. 8085 Microprocessor Programming & Interfacing- N.K Srinath-PHI

3. Microprocessor-Theory & Application-M. Rafiquezzaman;PHI
4. Microprocessor- B.Ram

Module 3. Communication: Theory

COMMUNICATION

Spectral analysis: Fourier transform theory, energy, power, parseval's theorem, convolution theorem, power spectral density function(PSDF) and energy spectral density functions (ESDF) and their physical interpretation, auto- correlation function, Relation between PSDF and the autocorrelation functions, Review of signal transfer in linear systerms, the ideal low pass filter and distortion less transmission, Paley-Weiner criterion Importance of channel bandwidth.
Radio wave propgation: Characteristic of electromagnetic wave, propagation of radio waves at different frequencies. structure of the atmosphere. Ground wave propagation, sky wave, critical frequency and virtual height. Maximum usable frequency and skip distant (quallitative discussion only).
Amplitude modulation systems: Need for modulation, time and frequency domain expression, transmission requirement-Bandwidth, power, Method of generation-linear(tuned collector) and non- linear(square-law) modulators, Demodulation-square law and envelop detectors, time and frequency domain expression for DSBSC-AM.
Frequency (FM) and phase Modulation (PM): Time and frequency domain expression, phasor diagram for FM and PM. Transmission requirements-Bandwidth, power (Comparison with AM), Method of generation- Direct (parameter variation), Indirect (Armstrong), Demodulation using limiter-discriminator(Foster-Seely), Equivalence between FM and PM, AM and narrow-band FM.
Noise:Thermal, shot and flicker noise, Calculation of noise in linear system, noise bandwidth, Noise in two-port networks-SNR ratio, Noise figure, noise temperature, their interrelationship, Noise in cascade stages.
Pulse modulation system: Basic idea of pulse modulation system-sampling theorem, Nyquist criterion, Basic idea (waveform and principle of generation) of PAM, PWM, PPM.

Reference Books**:**

1. Electronic Communications: D. Roody and J. Coolen
2. Communication Systems: S. Haykin
3. Communication Systems: A. B. Carlson
4. Principle of Communication Systems: H. Taub and D.L. Schilling
5. Modern Digital and Analog Communication Systems: B. P. Lathi

Module 4. Computer Science: **Theory**

Computer Organization: Input/output devices. memory-different types and memory hierarchy, structure of a basic RAM cell.

Data structures: concept of stack, Queue, link-list, binary searching, bubble sorting, quick sorting (algorithm only).

Computer Networking: ISO-OSI reference layer (brief idea of functions of each layer). TCP IP architecture brief idea and comparison with ISO-OSI model. Transmission media-types and characteristics.

LAN- Network topologies-star, Mesh, Bus, Ring, basic difference between citcuit switched and packet switched network. Access control mechanism-CSMA/CD, CSMA/CA, TOKEN PASSING.

Network devices-(Basic working principle only) NIC, hub, repeater, switch, Bridge, router.

Reference Books**:**

1. W Stallings, "Data and Computer Communication" –7/e Pearson

2. B A. Forouzan, "Data Communication and Networking",4/e, McGraw Hill,2006

3. Carpinelli**:** Computer systems Organization & Architecture

Paper VII - ELTA 122 303

Module 1. Linear Integrated Circuits and Communication Systems: Practical

Experiment on op-amp:

1. To study a simple voltage comparator using a Zener diode and an op-amp.
2. To study the performance of the Schmitt trigger using op –amp.
3. To study the frequency response of first order active high pass and low pass filters
4. Using op –amp.
5. To construct and study triangular and square wave generator using op –amp and related circuit elements.
6. (a) To study RC lead-lag network of the Wien bridge to be constructed and hence to find out the frequency for zero phase-shift and maximum V_{out}/V_{IN} respectfully.
7. (b). To construct a Wien bridge oscillator on a breadboard using op-amp and diode as amplitude stabilizer. Study the wave form of the oscillator, calibrate it using CRO and compare the frequency with the theoretical value.
8. To study the performance of the R-2R ladder D/A converter using and op-amp.

Experiments on IC 555:

9. To construct and study the output waveform of (i) a monostable (ii) an astable multivibrator and (iii) a voltage-controlled oscillator (VCO) using IC 555.

Experiments on amplitude modulation (AM).

10. (I) To construct an amplitude modulator and demodulator and find out the value of modulation index for m=100%.
11. (ii) Find out the highest frequency the envelope-detector can follow without attenuation for m=100%.
12. (iii) To study how m changes and the output of the detector changes with the audio level.
13.

References:

1. **L**aboratory Manual for op-amp and Linear ICS by Bell-PHI
2. Basic Electronics A Text Lab Manual by Zbar-TMH.
3. Practical physics by Rakshit and Chattopadhyay.

Module 2. Assembly Language Programming on the 8085 Microprocessor: Practical

Sample Problem:

Draw the flow chart and write and execute the pertinent Assembly Language Program for the following problem:

1. Add two 8-bit numbers store in memory locations and store the result in another memory location. Keep a provision for a carry, which may or may not have been generated.

Hints (i). Use the command ADD r (r is any general purpose register B, C, D, E, H, L).
(II) Use the command ADD M(M is a pointer to memory location store in H-L register pair).

2. Subtract one 8-bit number from another, the numbers being stored in two memory location.

Hints(i) Use the command SUB r (r is any general purpose register B,C, D, E,H AND L).
(II). Use the command SUB M (M is a pointer to the memory location stored in the H-L register pair).

3. Add two 16-bit numbers stored in two pairs of consecutive memory locations and store in a third pair of consecutive memory locations. Keep a provision for a carry, which may or not have been generated.

Hints : Use the commands: LHLD XXXX, DAD rp, SHLD XXXX for the purpose. (xxxx msans the address of a memory location and rp represents a register pair.)

4. Multiply two 8-bit numbers stored in two consecutive memory locations and store the result in a third memory location.

(i) Use the repeated addition algorithm.

(ii) Use the shift and add algorithm.

5. Assume that the integers 0, 1, 2, ……….. , 9 are stored in 10 consecutive memory locations. Make the microprocessor fetch the numbers one by one and add them. Store the result in a memory location.

Hints: Use the commands LXI H xxxx, INX H and ADD M.

6. Place an 8-bit number in a memory location. Let the microprocessor fetch the number and after checking , place in the next memory location, 00 H if the number happens to be zero and 01 H if the number happens to be otherwise.

Hints: Use the command ANI xx (xx stands for any 8-bit data.)

7. Store an 8-bit number in a memory location and a larger number in the next memory location. Lode the smaller number from the first memory location onto the Accumulator. Go on incrementing the contents of the accumulator till its contents equal the accumulator is incremented. Comment on the results.

Hint: Use the instruction CMP r.

8. Store two 8-bit numbers in two consecutive memory locations. Compare the two numbers and place the larger number in the first memory location and the smaller in the second.

Hints: Use the instruction CMP r

9. Assume that the 8-bit number XY H is stored in a memory location. Make the accumulator fetch the number and then store 0X H and 0Y H in the next two memory locations. Hints: use the instructions ANI 0F H ,ANI F0 H and RLC.
10. Fetch a byte from a particular memory location and count the number of 1s and 0s. plays the results in two consecutive memory locations.
11. Given an array of ten 8-bit numbers in ten consecutive memory locations, separate the even numbers from the odd. Write the even numbers in a set of consecutive memory locations and the odd numbers in a separate set of consecutive memory locations .
12. A set of ten 8-bit signed numbers are stored in ten consecutive memory locations. Fetch the numbers from the memory , check each number to determine whether it is positive or negative. Reject all negative readings. Add all positive readings and place the 8-bit output in a memory location. If the output is of more than 8-bits then store FF H instead in the memory location.

Hints: use RAL and RAR instructions.

13. Clear or reset all the five flages. Lode 00 H in the accumulator and demonstrate that the zero flag is not affected. Logically OR the accumulator with itself to set the zero flag and display its contents.

Hint: Use the stack instructions: LXI SP xxxx, PUSH PSW , POP PSW.

14. Load a 16-bit count on to the register pair –BC . Write a delay subroutine to introduce a delay in the main program. Do this by decrementing the BC- pair by one till it contains zero or in other words by repeating the delay loop N number of times where a equals the count set in the BC pair. Call the subroutine from the main program twice. Hint: Use CALL and RET instruction to access the subroutine. Use LXI rp xxxx, DCX r , ORA r

and JNZ xxxx to create the delay loop. The above problems are only reprentative in character . Problems different form the above but similar in nature and complexity may also be set in the final examinations.

REFERENCES:

1. 8085 microprocessor by Gaonkar- Penram international
2. Microprocessors – interfacing and applications by Renu singh and B. P. Singh – New age.
3. Microprocessors and peripherals by S.P. Chowdhury and Sunetra Chowdhury – scitech.

Paper VIII - ELTA 122 304
Module 1. Digital Electronics: Practical

1.(a).Construct a half adder and full adder using NAND gates.
(b).Construct a full adder using 2 half adders and an OR gate.
(c).Construct a 4-bit adder-substractor with IC 7483 and EX-OR gates.
(d). Construct a BCD adder that adds two BCD numbers and to produce the sum in BCD code as well as. Use two 4-bit binary adder (IC 7483) chips (The sum may be than or equal to the BCD equivalent of decimal 19).

2. Design a 2-bit magnitude comparator which compares the two 2-bit numbers A=A1A0 and B=B1B0 and shows a high at any one of the three outputs (A=B, A<B and A>B)using logic-gates.

3.(a). Design a 4:1 multiplexer using TTL NAND gates.
(b). Implement a Boolean function expressed in sum-of minterms from: say sum(0,1,2,4,8,15) with a multiplexer. U SE THE 8:1 IC 74151 multiplexer chip for purpose.

4(a). Construct a 2:4 decoder using TTL nand gates.
(b). study the 3:8 decoder chip IC 74138. show how you can use two 3:8 decoders to design a 4:16 decoder. verify the truth tables.

5(a). Construct SR, D and JK flip flops using TTL NAND gates and verify their truth-tables.Convert any one type of flip-flop to another.
(b). Construct a Master/Slave JK flip-flop using all NAND Gates and Verify its function table.

6. Study the dual negative-edge triggered J-K flip flop chip IC 7473.
(a). Use four such chips to design a 4-bit ripple counter which counts (i) in the up direction and (ii) in the down direction. study the output waveforms on an oscilloscope.
(b). Modify the above circuit by including a NAND gate to construct a MOD-10 counter. study the output waveforms on an oscilloscope.
(c). Construct a 4 bit synchronous counter with the 4 JK flipflops. study the output waveforms on an oscilloscope.

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Reference:

Digital logic and computer Design by M. Mano.
Digital circuits volomes 1 and 2 by D. Raychowdhary-Platinum.
Practical physics by volume 2 by B. Ghosh.

Module 2. Computer Programming in C-Language: Practical

Draw the flochart and write the source program for performing the following tasks.

1. Calculate the first N Fibonacci number where N may be read from the keyboard.
2. calculate the factorial of an integer M where M is given. Write the program (a) without using recursion (b) using recursion.
3. calculate the standard deviation of an array of N numbers which may be read from keyboard.
4. (a) Given two m by n matrices: A and B. Calculate A+B and A-B. Read in the individual elements form the keyboard.

   (b). Given an m by k matrix A and a k by n matrix B. Evalute A*B.
5. Obtain the sum of the N terms of (a) an A.P. series (b).a G.P. series. Read in required variables from the keyboard.
6. Sort an array of numbers in (a) ascending and (b) descending order using the Bubble sort algorithm. You may also use a faster sorting algorithm if you like.
7. Calculate the function 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.
8. Use Least squares Regression to fit a straight line of the form y=mx+c to a given table of data points.

X	1	2	3	4	5
Y	3.0	5.0	7.0	4.5	6.6

   The above set data is for indicative purpose only.
9. solve a given polynomial equation numerically using the Newtow-Raphson method. Read in the polynomial cofficients and the accuracy from the keyboard.
10. Given a function f(x)=x2.calculate using simpson's method integration f(x)dx within limits of x=0 to x=1.Compare the answer with that obtained analytically.

Reference:

Numerical Methods for scientists and Engineers by Rajaraman-TMH.
Numerical Methods in C and Fortran by Balaguruswamy-TMH.
Programming in C by Gotfried, Schaum series-TMH.
C programming by Balaguruswamy-TMH.
Computer Fundamentals and C programming by Dey and Ghosh-Oxford.