VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. - I

Electronics

(In force from June-2001)

There will be four papers each of 75 marks (53 Ext.; 22 int.) and of three hours duration. There will be three practicals each of three hours duration and total marks will be 200 (140 ext., 60 int.)

Paper –I	: Section-1 Quantum Mechanics
	: Section-II Mathematical and Computational Methods
Paper –II	: Section-1 Electromagnetic Fields and Waves
	:Section- II Physics of Electronics Materials
Paper-III	: Section-1 Communication
	:Section-ll Solid State Devices
Paper-IV	: Section-1 Analog and Digital Circuits
	:Section- II Measurement and Instrumentation

Practicals

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Paper-I

Quantum Mechanics and Computational and Mathematical Methods

Section -I

Quantum Mechanics

De Broglie hypothesis, waves in quantum mechanics, matter waves and their physical meaning, wave packet, operators, observables expectation value, commutators, uncertainty principle, time dependent and time independent Schrodinger equation, stationary State, particle in infinite square well, particle in a potential well (finite square well) potential barrier tunneling phenomena, harmonic oscillator.

Angular momentum, eigenvalue and eigen function for]2 and]z, Pauli Spin matrices, addition of angular momentum, clebsh Gordan coefficients.

Time independent perturbations, transmission line model, perturbation applied to transmission line problem, particle in a modified infinitely deep one dimensional potential well, time dependent perturbation, step function perturbation, harmonic perturbations, electric dipole transitions, periodically loaded transmission line. Spherically symmetric potential, two-body problem, hydrogen like atom problem, degeneracy, vibration and rotation spectra of diatomic molecules.

Two isolated wells, double well potential, ammonia molecule as a two state system, Kronig-Penny model.

Scattering theory, partial wave analysis, Born approximation, scattering from a screened coulomb potential. Identical particles with spin and exclusion principle, scattering of identical particles, isotopic spin.

Experimental necessity of Dirac's approach, Dirac's equation, spin and magnetic moment of the electron, reduction to non-relativistic limit, difficulties associated with single particle relativistic equations.

Recommended Books

1. P .A. Bindsay, Introduction to Quantum Mechanism for Electrical Engineers, McGraw Hill, 1967.
2. A.K. Ghatak, Quantum Mechanics, Macmillan 1996.
3. A.K. Ghatak and S.L. Loknathan, Quantum Mechanics.
4. D.I. Schift, Quantum Mechanics, McGraw Hill, 19

Section -II
Mathematical and Computational Methods

Ordinary differential equations, solution in closed form, power series solutions, miscellaneous approximate methods, the W.K.B. Method.

Integral transforms, Fourier transforms, Laplace transforms, other transform pairs, applications of integral transforms.

Special functions, Legendre functions, Bessel functions, hypergeometric functions, Confluent hypergeometric functions, Hermite functions, spherical harmonics.

Partial differential equations, example, general discussion, separate on of variables, integral transform method.

Mapping, conformal transformations.

Binomial, Poisson and Gaussian distributions, properties of distributions, fitting of experimental data.

Computational Methods, Finite differences, difference tables, interpolation errors in interpolation formula, matrix inversion, Cramer's rules eigenvalues and eigenvectors of a matrix, Jacobi method, Householder method, numerical integration, Newton-Cote's formula, trapezoidal, Simpson and Weddle rules, Gauss-Legendre open quadrature, numerical solutions of ordinary differential equations, Enler, Picard and Taylor series methods, Runge-Kutta and Prediotor-Corrector methods, least squares techniques and applications.

Recommended Books

1. J. Mathew and R.L. Walkar, Mathematical Methods of Physics, Benjamin (IBH),1979.
2. H. Margenau and G.M. Nurphy, Mathematics of Physics and Chemistry, East-West Press,
3. P.M. Morse and H. Feshback Methods of Theoretical Physics, Vols. 1-2, McGraw Hill, Kogakusha, 1953.
4. V.M. Trivedi, Ganitiya Bhautikshashtra, Vol. 4, Univ. Book Production Board, Ahmedabad, 1974.
5. M.J. Mann, Numerical Analysis, MacMillan 1982.
6. J.B. Scarboroush, Numerical Mathematical Analysis.
7. V. Rajaraman, Computer oriented Numerical Methods, PHI, 1994.
8. S.D. Come, and C. De Buer Elementry Numerical Analysis.
9. M.P. Boas, MMP.

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Paper-II

Electromagnetic Fields and Waves, Physics of Electronic Materials

Section -I

Electromagnetic Fields and Waves

Review through problems of vector algebra and vector calculus, Divac's delta function, Helmholtz theorem, Scalar and vector potential, statement and application of Coulomb's lawand Gausa's law, change distribution, potential of a localized change distribution, electrostatic boundary condition, energy of a point change distribution and a continuous change distributions.

Electrostatic energy, Poisson's equation, Laplace's equation in one, two and three dimensions, uniqueness theorem, method of images, multiple expansion, Gausslaw in diectric, boundary conditions, electrostatic energy in diectric medium, electrostatic for macros conic media, special problems involving linear dielectrics.

Biot-Savart law, applications, of Acbere's law, comparison of electrostatics and magnetostatics, magnetic vector potential multiple expansion of magnetic potential, macrosconic equations, boundary conditions on Band H.

Maxwell's displacement current, Maxwell's equations, gauge transformations, Poynting's theorem. Solution of Maxwel1's equation for charge-free unbounded region, uniform wave, uniform plane waves relation between E and H in a uniform plane wave, polarization, characteristic wave impedance and propogation constant, depth penetration in a good conductor, surface impedance of good conductor to sinusoidal currents, waves incident normally and oblizuely on boundary between perfect dielectrics, Pounting vector for a plane wave in a dielectric, Poynting's theorem, flow of direct current in cylindrical register and co-axidl cable, poynting vector with time-varying fields.

Essential conditions for guided waves, TEM wave in coaxial cables and two wire transmission lines, rectangular wave guides electric and magnetic field inside rectangular wave guides, solution of wave equations for rectangular wave guides, transperse electric and magnetic field in rectangular waveguide, out off frequency and wave length, circular waveguides, retarded magnetic vector potential", magnetic and electric field of oscillating Hertzian dipole, radiation field of Hertzian dipole antenna, directional characteristics of antenna, radiation pattern of dipole antenna, arrays, four and eight element arrays.

Recommended Books

1. V. V. Sarwate, Electromagnetic fields and waves, Wiley Eastern, 1993.
2. E.C. Jordan and R.G. Bal mann, Electromagnetic waves and Radiating Sy Stoms, Pill.
3. B.B. Laud, Electromagnetics, Wiley Eastern.
4. J.D. Jackson, Classical Electrodynamics, Wiley, 19
5. D.J. Grittith, Introduction to electrodynamics, Pill, 199
6. M.A. Wazed Miah, Fundamentals ofElectromagnetics, TMH, 1982.
7. J .B. Mansion, classical Electromagnetic Radiation, Academic Press, 1968.

Section -II
Physics of Electronic Materials

Crystal lattice, translation symmetry, unit cell, basis and crystal structure, crystal classification, Miller indices, simple lattices, closed packed structure, diamond structure, reciprocal lattice lane equation Bragg's law, Brioulline zones, structure .factor methods of structure analysis, types of probe beams, experimental crystal structure determination, diffraction experiments with various particles x-ray interferometry, x-ray topography, diffraction of neutrons.

Thermal conductivity, normal process, umklapp process thermal expansion, scattery mechanism for phonons, review of behaviour of phonon conductivity, experiments at temperature.

Drude theory of metals, electrical conductivity Hall effect and magnetoresistance, Somm crfeld theory of metals, and electrical conductivity, Weidman-Franz law, failure of free electron 'model.

Classification of solids, classification of insulators, II-VI ionic crystals, III-IV crystals molecular crystals, hydrogen crystals.

Periodic potential, Bloch's theorem, Kronig-Penny Modd reduced zone scheme, effective mass, tight binding approximation, examples of band structure, photoemission spectroscopy.

Dia magnetism and paramagnetism, Pauli paramagnetism and its measurement, ferromagnetism, Heiseuberg theory, anti-ferromagnetism, spinwaves, magnetostutic spin waves, surface magnetism.

Characteristics, structure and experimental study of Fermi surfaces, quantum oscillations and topology of Fermisurfaces.

Homogeneous and inhomogeneous semiconductors, general properties of semi- conductors, examples of semiconductors, doping of semiconductors, Hall

effect, cyclotron resonance, conductivity of semiconductors, quantum Hall effect, semiconductor epitaxy. General properties of semiconductors, typical semiconductor band structures, number of carriers in semiconductors, extrinsic care impurity levels, semiclassical treatment of inhomogeneous solids, junction in equitimum.

Ferroelectricity, piezoelectricity, effects of dielectrics, important requirements of good insulating materials, some important insulating materials.

Super conductivity, historical introduction, survey of super conductivity, zero

electrical resistance, Meissner effect, magnetic phase diagram energy gap, flux quantation, type I and II super conductors, London equations, B.C.S. theory, predictions ofBCS theory, Jscphgm effect and tunneling, new super conductors.

Recommended Books

1. S.O. Pillai, Solid State Physics, New Age International, 1999.
2. R. Dalvin, Introduction to Applied Solid State Physics, Plenum 1981.
3. D.L. Weaire and C.G. Windsor, Solid State Science, Adam Hilger, 1987.
4. H.V. Keer Principle of Solid State, Wiley Eastern 1993.
5. T.V. Ramakrsihnan and C.N.R. Rao, Superconductivity Today, Wiley Eastern, 1992.
6. H. Ibach, H. Lath, Solid State Physics, Narosa Publishing House, 1991.
7. C.M. Kachhava, Solid State Physics, TMR, 1990.
8. A.J. Dekker, Solid State Physics, Mcmillan, 19
9. H. W. Ashcroft and N.D. Mermin, Solid State Physics, Holt-S International Editing, 1981.
10. C. Kittel, Introduction to Solid State Physics, Wiley, 1996.

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Paper-III

Communication-1 and Solid State Devices

Section -I

Communication-I

Communication system, information, transmitter channel noise, receiver, need for nodulation, bandwidth requirements.

Spectral analysis, sampling function, response of a linear system, normalized power in a Fourier expansion, power spectral density, effect of transfer function on power spectral density, convolution, power and energy transfer through a network, band limiting of wave forms, power and energy transfer through a network, band limiting of wave forms, power and cross correlation, autocorrelation, auto correlation of periodic and non-periodic wave forms, auto correlation of other wave forms.

Probability, random variables, transformation of random variables, random processes, stationarity, correlation and covariance functions, regularity and ergodicity, Gaussian process, central linlit theorem, transmission of a random process through a linear filter.

Frequency translation, a method of frequency translation, recovery of base band signal, double side band suppressed carrier modulation, generation of LSBSC waves, coherent detection of DSBSC waves, vestigial side band modulation, comparison of various amplitude modulation systems, multiplexing, FDM, non-linear distortion.

Spectrum of an FM signal, FM generation-parameter-variation method, stereophonic FM broadcasting, spikes, occurrence, characteristics, suppressed, phase locked loop, analysis of phase locked loop, second order phase looked loop.

Noise, external and internal noise, noise calculations, noise figure, noise temperature, noise in amplitude modulated systems, advantage of superhetrodyne principle, DSB-SC, square law and envelop demodulator, noise in FM, calculation of output signal and noise power, preemphasis and deemphasis-single channel, in commercial PM broadcasting.

Elements of a digital communication system, information source, source encoder/decoder, modulator, demodulator, channel encoder/decoder, other functional blocks.

Sampling theorem, low phase signal pulse amplitude modulation, channel bandwidth of a P AM signal, signal recovery through holding, pulse time

modulation, methods of generating pulse-time modulated signals, cross-talk in PTM systems.

Noise communication channel, quantization of signals, quantization error, compancing pluse code modulation, PCM system, Delta and adaptive delta modulation, digital carrier modulation schemes, PSK, DPSK, PSK.

Smith chart and its applications, transmission line components, colour television, transmission and reception, pulsed radar, radar equation, Doppler radar, radar signal processes, estimation error, passive syst.

Recommended Books

1. R. Taub and D.L. Schilling, Principles of Communication System, McGraw Hill-Kogakusha, 1971.
2. S. Haykin, Communication Systems, Wiley Eastern, 1982.
3. G. Kennedy, Electronic Communication System, McGraw Hill, International Book Co., 1977.
4. S. Sam Shanmugum, Digital and Analog Communication Systems, John Wiley and Sons, 1979.
5. H. Stark and P.B. Tuteur, Modern Electrical Communications, Prentice Hall, 1979.
6. D. Roddy and J. Coolen, Electronic Communications, PHI, 1987.

Section -II
Solid State Devices

Classification of semiconductor devices, specific remarks, carrier transport phenomena, phenon spectra, optical thermal and high field properties of semiconductor, basic equation for semiconductor device operation.

p-n-junction diode, depletion region and depletion capacitance, current-voltage characteristics, junction breakdown, transient behaviour and noise, terminal functions, hetrojunction.

Tunnel diode and backward diode, effect of high doping, tunneling process, excess current, equivalent circuit, backward diode.

Junction transistors, microwave transistors, power transistors, switching transistor, unijunction transistor.

p-n-pan and junction field affect devices, Schokley diode and semiconductor- controlled rectifier, junction field-effect transistor and current limiter.

Metal semiconductor devices, schottky effect, energy band relation and metal semiconductor contact, current transport theory in schottky barriers, measurement of schottky barrier height, clamped transistor, schottky gate FET

and metal semiconductor IMP A TT diode, Mott barrier, point contact rectifier and ohmic contact, space charge effect diode. SCR, Triac, Diac, IGBT, Power MOSFLET. Optoelectronic devices, electroluminescent devices solar-cell, photo detectors.

Bulk-effect devices, bulk differential negative resistance, Ridley-watkins-Hilsum (R WH) mechanism, gunn oscillator and various modes of operation, associated bulk effect devices.

Recommended Books

I. S.M. Sze,Physics, ofsefuiconductor devices, Wiley-Interscience, 1969.

2. D.A. Frazer, The Physics of semiconductor devices, Clarendon Press, 1977.

3. . T.H. Beeforthand and J.H. Goldsmid, Physics of Solid State Devices, Plenum, 1970.

4. R.M. Warner and B.Z. Grang, Transistors, John Wiley, 1983.

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Paper-IV

Analog and Digital Circuits Measurement and Instrumentation

Section -I

Analog and Digital Circuits

MOSFET, enhancement MOSFET, enhancement MOSFET volt ampere characteristics, MOSFET circuit symbols, MOSFET as a resistance, biasing the enhancement MOSFET, small signal operation of the enhancement MOSFET amplifier, MOS amplifier with enhancement MOS load, MOS analog switches, CMOS devices.

BJT biasing for integrated circuits, Widlar current source, three-transistor current sources, discrete component biasing and design, common-emitter amplifier with an emitter resistance high frequency response of a common-emitter stage, common-source stage at high frequency, emitter and source followers at high frequencies, time-constant method of obtaining the response.

General analysis of multistage feedback amplifiers, multiloop feedback amplifiers, stability, test for stability, compensation, frequency response of feedback amplifier the double pole transfer functions, phase margin of the two-pole feedback amplifier three-pole feedback amplifier response, approximate analysis of a multiple feedback amplifier, approximate determination of the open-loop poles, compensation revisited.

BIFET, BIMOS circuits, three stage operation amplifiers, other types of operation amplifiers, MOS operational amplifier.

A general form of oscillator configuration, crystal oscillators, voltage time-base generators, step generators, signal processing, sample and hold circuits, analog multiplexer and demultiplexer, A to D and D to A converters, single amplifier biquad sections, multiple op-amp biquad sections, switched-capacitor filters, exponential amplifier, analog multipliers, precision AC/DC converters.

Regulated power supplies, monolithic regulator, switching regulator, additional switching regulator topologies.

ROM two-dimensions addressing of ROM, ROM applications, NMOS, inverter, propogation delay of an NMOS inverter, NMOS logic gates, CMOS inverter, CMOS logic gates, amitter coupled logic circuits, programmable RMOS, erasable ROMs, programmable logic arrays.

Dynamics MOS shift register, rationess shift register stages, CMOS domino logic RAM, Read-write memory cells, tripolar RAM cells, charge-coupled devices, CCD structures, integrated injection logic.

Recommended Books

1. J. Millman and A. Grabel, Microelectroics, McGraw Hill, 1987.
2. A.S. Sedra and R.C. Smith, Microelectronic Circuits, Holt Saunders, Japan, 1982.
3. J. Millman, Microelectronics, McGraw Hill 1979.
4. D.E. Hodges and H.G. Jackson, Analysis and Design of digital integrated circuits, McGraw Hill, 1983.
5. P .R. Gray and R. G. Meyor, Analysis and design of analogy integrated circuits, John Wiley, 1984.

Section -II
Measurement and Instrumentation

Measurement generalization measurement system, basic concepts of dynamic measurement, system response, distortion, analysis of repeated measurements, mathematical description of data distribution functions, properties of distribution functions, propogation of errors, analysis of data, chisquare test, correlation coefficient, standard deviation of mean, graphical analysis, multiparameter experiments.

Experimental design, transducers, classification of transducers, transducer characteristics, selection of instrumentation transducer, transducer as an electrical element, measurement methods, temperature transducers, variable-resister transducer, differential transformer, L VDT , Capacitive, piezoelectric and photoconductive transducers, photoemissive detectors, photodiode, phototransistor, ionization transducers, magnetic search coil, Hall transducer, digital displacement transducer, stain gages, different types of strain gages, theory and applications of strain gages.

Signal to noise consideration, noise in frequency domain, sources of noise, signal to noise and experimental design, frequency and bandwidth consideration, bandwidth control, signal to noise enhancement, digital correlation and auto correlation methods, signal recovery, signal filtering, signal averaging, signal coding.

Fundamental concept of an instrument, input and output, configuration of measuring instruments and instrument systems, methods of correction for interfacing and modifying inputs, instrumentation amplifier, basic characteristics, isolation amplifiers.

Digital voltmeters and multimeters, psychological testing, polarography, photovoltaic cell, light emitting devices.

Recommended Books

1. M. Sayer and A. Mansingh, Measurement, Instrumentation and experimental design for Physics and engineering PHI, 2000.
2. B.E. Jones, Instrumentation, measurement and control, TMH, 1981.
3. A.K. Sawhriey, A course in electrical and electronic measurements and instrumentation, Dhentam Rai and Sons, 1998.
4. C.S. Rangan, G.S. Sharma, V.S. Mani, Instrumentation, Devices and Systems, TMH, 1983. (1998).
5. J.P. Holman, Experimental Systems, applications and design McGraw Hill, 1990.
6. F .O. Deoblin, Measurement Systems, applications and design McGraw Hill, 1990.
7. A.J. Difenfender, Principles of electronic instrumentation W.B. Saunders (Toppan) 1972.
8. S.K. Singh, Industrial Instrumentation and control TMH, 1990.
9. D. Patranabis Principles of Industrial Instrumentation, TMH, 1996.
10. J. Jha, M. Puri, R.S. Kanav M. Kasav, Elements of Electronic Instrumentation, Navosa, 1996.

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Laboratory Wok
List of Experiments

6 hrs/week

1. To design, build and test a two stage R-C coupled amplifier.
2. To design, build and test a mono-stable multivibrator.
3. To design, build and test Schmitt Trigger circuit.
4. To design, build and test Wein bridge oscillator using IC 741. ,
5. Operational amplifier applications (voltage regulator, function generator).
6. Study of phase-locked loops.
7. To design, build and test adder and subtractor.
8. To design, build and test analog to digital converter.
9. To design, build and test digital to analog converter.
10. To design, build and test (i) binary to gray code converter (ii) gray to binary code converter (iii) combined gray to binary to gray code converters.
11. To design, build and test a RUM using diode matrix for BCD to seven segment code conversion for 7-segment LED display and study 74147/74147 IC.
12. To design, build and test (i) a 4 bit binary upcounter using JK flip-flops and its modification to get a 4 bit down counter (ii) a module N counter using JK flip- flops and other gates.
13. To design the basic RAM memory cell and its conversion to (i) 4 x I RAM and (ii) 1 x 4 RAM.
14. Electronic construction technique (Circuit layout and printed circuit technique).
15. Study of characteristics of FET and using it to design, build and test and amplifier.
16. Study of characteristics of UJT and using it to design build and test an oscillator .
17. Study of characteristics of thermister, varactor diode.
18. Energy bad gap ofthermister.
19. Study of characteristics of Triac, Diac, SCR.
20. Study of Characteristics of photo diode.