

VEER MARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part - II

PHYSICS

(In force from June 2000)

Each paper will be of 100 marks (70 external, 30 internal) and of three hours duration. Total marks of theory will be 300. There will be practical and/or project work and total marks of practical will be 200. A student may offer dissertation in lieu of entire practical work. The dissertation shall be prepared under the guidance of a recognized guide for Ph.D. degree.

Paper - I (Compulsory) :

Section – I : Numerical Analysis and Computer Programming

Section – II : Subatomic Physics

Group - I :

Paper – II : Electronics – I

Paper – III : Electronics – II

Group-II :

Paper – II : Theoretical Physics

Paper – III : Computer Applications in Physics

Group – III Paper – II : Materials Science – I

Paper – III : Materials Science - II

VEER MARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part - II

PHYSICS

Paper – I

(Numerical Analysis and Computer Programming, Subatomic Physics)

Section – I

(Numerical Analysis and Computer Programming)

Errors in interpolation formula, Matrix inversion, Cramer's rule. 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, Euler, Picard and Taylor series methods, Runge – Kutta and Predictor Corrector methods, Least square techniques and applications.

Basic component of a digital computer, assembly language, compiler languages, algorithm flow charting, FORTAN language, character set, structure of a program, constants and variables, types of FORTRAN statements, format, input and output statements, control statements, arithmetic replacement statements, arrays, dimension statements, basic looping structure, DO, DO-WHILE, REPEAT UNTIL, IF-THEN-ELSE, logical expressions and assignments, function subprograms and function subroutines, good programming practices, Do's and Dont's in FORTRAN programming.

Introduction to C language, identifiers and keywords, data types, constants and variables, declarations and statements, representation of expressions, operations and library functions, data input and output statements, functions, arrays and pointers, pointer arithmetic, one and two dimensional arrays, Pointer representation of arrays, introduction to structures, random and sequential files, file handling in C.

Program writing in FORTAN and C for interpolation, integration, roots of equations, matrix diagonalization, solution of differential equations.

Recommended Books

1. V. Rajaraman, Computer Programming in FORTRAN 77, 1994.
2. C. Xavier, C Language and Numerical Methods, 1999.
3. M. J. Maron, Numerical Analysis, McMillan, 1982.
4. J. B. Scarborough, Numerical Mathematical Analysis, Oxford Books Co., 1962.
5. V. Rajaraman, Computer Oriented Numerical Methods, PHI, 1994.
6. S. D. Conte and C. De Boer, Elementary Numerical Analysis.
7. P. S. Grover, Programming and computing with FORTRAN 77 and 90.
8. B.W. Kernigham and D.M. Ritchie, The C Programming language, PHI, 1988.

VEER MARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part - II

PHYSICS

Section – II

(Subatomic Physics)

Motivation for studying nuclear and particle physics, brief history of developments in nuclear and particle physics, nucleo-synthesis, study of nuclear physics, cosmology and particle physics.

Fundamental interactions, classification of particles, fermions, bosons, leptons, hadrons (mesons and baryons), excited states, resonances.

Nuclear properties, nomenclature, symbols, charge, mass, charge and potential radii, spin, statistics, isospin, magnetic dipole moment, electric quadrupole moment, binding energy, semiempirical mass formula, nuclear stability.

Symmetric, discrete and continuous transformation, symmetry breaking and removal of degeneracy, parity, charge conjugation, time reversal, G-parity, strangeness and other quantum numbers, CPT theorem (statement).

Nucleon structure, quarks and leptons, static quark model of hadrons, magnetic dipole moment of baryon octet, hadrons mass and quark–quark interaction.

Measurement of life-times of excited states, theoretical predictions of decay constants, selection rules, internal conversion, zero-zero transition, nuclear isomerism, angular correlation, application of Dirac theory of beta decay, Fermi theory and its generalization, general form of weak interaction Hamiltonian, V–A interaction, universal fermi interaction, nuclear beta-decay, Kurie plots, comparative half-lives, selection rules, electron capture decay, double beta decay.

Nuclear models, evidence of shell structure, single particle shell model, magic numbers, Spin-orbit coupling, parity, spin and moments of nuclear ground states, Schmidt lines, evidence for collective motion, brief introduction to vibrational and rotational states, single particle motion in deformed potential.

Theories of nuclear reactions, partial wave analysis of reaction cross-section, CN formation and breakup, discrete resonances in CN, continuous states of CN, optical model of particle induced nuclear reactions, direct reactions, excitation of isobar analogue states, Spontaneous fission, induced fission, fission theories, heavy-ion reactions, Nuclear force, saturation property, charge independence, exchange forces, tensor force, symmetry and nuclear force, low energy n-p and p-p scattering, low energy scattering parameters, nuclear potential, Intermediate boson, quark–lepton universality and Cabibo theory, need for charm, CP violation, non-conservation of parity, Inelastic electron-proton scattering, Bjorken Scaling and patron model, need for gluons, quark jets, search for quarks, Reggepole theory and applications, neutrino mass, neutrino oscillation, brief introduction to standard model, possible future directions in nuclear and particle physics.

Recommended Books

1. H.A. Enge, Introduction to nuclear Physics, Addison Wesley, 1982.
2. R.R. Roy and B.P. Nigam, Nuclear Physics, Willey Edstern, 1986.
3. W.E. Burcham and M. Jacobs, Nuclear and Particle Physics, Addison, Wesley, 1998.

4. S.S.M. Wong, Introductory Nuclear Physics, PHI, 1996.
5. M.P. Khanna, Introduction to Particle Physics, PHI, 1999.
6. D.H. Perkins, Introduction to High Energy Physics, Addison Wesley, 1987.

Theory Tutorial (Section – I)
(Discussion and Problem solving sessions)

1. Error in numerical computation, error in construction of a model, approximations.
2. Truncation error and their estimation.
3. Propagated rounding error and methods to minimize it.
4. Order of convergence of iterative procedures.
5. Analysis of errors in various interpolation formulas.
6. Flow charts.
7. Errors in computed eigenvalues and eigenvectors.
8. Elementary programs using FORTRAN.
9. Elementary programs using C.

VEER MARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part - II

PHYSICS

Laboratory Tutorial

(Section - I)

Discussion of techniques of actual numerical computation, program writing concepts, error analysis to supplement actual exercise given for numerical analysis and computer programming.

Theory and Laboratory Tutorials

(Section II)

(Discussion and problem solving sessions)

1. Calculation of nuclear binding energy.
2. Shell model, collective model.
3. SU(2), SU(3)
4. Quarks, charge, mass, flavour, colour etc.
5. About W^+ and Z bosons.
6. Idea of parity and its violation.
7. Exoergic and endoergic reactions.
8. Idea of basic interactions and their unification.
9. Application of carbon dating C^{14} .
10. Idea of radioactive sources, their production.
11. Use of radioactive sources in industry and other branches of science.
12. Nuclear radiation hazard related to environmental pollution and health.

VEER MARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part - II

PHYSICS

Electronics-I

(Electronic Communications and Measurement & Instrumentation)

Group - I Section – I

Electronic Communications

Communication system, information, transmitter, channel, noise, receiver, need for modulation, 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 waveforms, power and cross correlation, autocorrelation, autocorrelation of periodic and non-periodic waveforms autocorrelation of other waveforms.

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

Frequency translation, a method of frequency translation, recovery of baseband signal, double sideband suppressed carrier modulation, generation of DSBSC waves, coherent detection of DSBSC waves, vestigial sideband modulation, comparison of various amplitude modulation systems, multiplexing, FDM.

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

Noise, external and internal noise, noise calculations, noise figure, noise temperature, frequency domain representation of noise, spectral components of noise, narrow band noise, response of a narrow band filter to noise superposition and mixing of noise, linear filtering, noise in amplitude modulated systems, advantage of superhetrodyne principle, DSBSC, square law and envelop demodulator, noise in FM, calculation of output signal and noise power, preemphasis and deemphasis: signal channel, in commercial FM broadcasting.

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

Sampling theorem, low pass signals, pulse amplitude modulation, channel bandwidth for a PAM signal, signal recovery through holding, pulse time modulation.

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

Smith chart and its applications, transmission line components, colour television, transmission and reception, pulse radar, radar range equation, Doppler radar, a brief introduction to satellite communication.

Recommended Books

1. H. Taub and D.E. Schilling, Principles of Communication system, McGraw Hill-Kogakusha, 1986.
2. S. Haykin, Communication Systems, New Age International, 1983.
3. G. Kennedy, Electronic Communication Systems, McGraw Hill, International Book Co., 1985.
4. B. P. Lathi, Modern Digital and Analog Communication Systems, John Wiley and Sons, 1998.
5. H. Strok and F.B. Tuteur, Modern Electrical Communications, Prentice Hall, 1979.
6. D. Roddy and J. Coolen, Electronic Communications, PHI, 1988.
7. K. Sam Shanmugam, Digital and Analog Communication Systems, John Wiley & Sons, 1979

Section – II

Measurement and Instrumentation

Measurement, generalized measurement system, basic concepts of dynamic measurement, system response, distortion, analysis of repeated measurements, mathematical description of data distribution functions, properties of distribution functions, propagation of errors, analysis of data, chi square test, correlation coefficients, 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-resistor transducer, differential transformer, LVDT, Capacitive, piezoelectric and photoconductive transducers, photoemissive detectors, photodiode, phototransistor, ionization transducer, magnetic search coil, Hall transducer, digital displacement transducer, strain 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 interfering and modifying inputs, Instrumentation amplifier, basic characteristics, isolation amplifiers, analog signal processing, high speed A/D, D/A conversions, digital instrumentation FFT, sampling time and aliasing, grounding, shielding.

Stimulated and spontaneous emission, population inversion, methods of population inversion, laser action, laser rate equation for a three level system, various types of solid, liquid and gas lasers, fiber optics, applications of lasers and fiber optics in communication.

IEEE 488 interface bus, use of electronic spread sheet in measurement and instrumentation.

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. Sawhney, A course in electrical and electronic measurements and instrumentation, Dhanpat 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 Methods for Engineers, McGraw Hill, 1994.
6. E.O. Deoblin, Measurement Systems, applications and design McGraw Hill, 1994.
7. A.J. Diefenderfer, Principles of electronic instrumentation W.B. Saunders (Toppan), 1972.
8. K. Thyagrajan and A.K. Ghatak, Laser theory and applications, Macmillan (India), 1984.

VEER MARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part - II

PHYSICS

Paper-III

Electronic – II

Microelectronics and Computer, Microprocessor

Group - I Section – I

Microelectronics

MOSEET, 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.

Monolithic integrated circuit technology, planar process, bipolar transistor fabrication, fabrication of FETS, CMOS technology monolithic diodes, metal semiconductor contact, integrated circuit resistors, capacitors, integrated circuit packaging, characteristics of integrated circuit components, microelectronic circuit layout.

BJT biasing for integrated circuits, Widlar current sources, 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 function, phase margin of the two pole feedback amplifier, three pole feedback amplifier response, approximate analysis of a multipole feedback amplifier, approximate determination of the open-loop poles, compensation revisited.

BIFET, BIMOS circuits, 3 stage operational amplifiers, other types of operational 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/D and D/A converters, signal amplifier biquad sections, multiple op-amp biquad sections, switched – capacitor filters, exponential amplifier, analog multipliers, precision AC/DC converters.

Regulated power supply, polyphase regulators, a switching regulator, additional switching regulator topologies.

NMOS, inverter, propagation delay of an NMOS inverter, NMOS logic gates, CMOS inverter, CMOS logic gates, emitter-coupled logic circuits, programmable ROM, erasable ROM, programmable array logic, programmable logic arrays.

Dynamic MOS shift register, ratio less 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. Grable, Microelectronics, McGraw Hill, 1987.
2. A.S. Sedra and K.C. Smith, Microelectronic Circuits Holt-Saunders, Japan, 1991.
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. Meyer, Analysis and design of analog integrated circuits, John Wiley, 1984.

Section – II

Computer, Microprocessors

Review of number systems, ALU, construction of ALU, integer representation, BCD adder, 1S, 2S, 9S complement systems, shift operation, basic operations, binary multiplication, decimal multiplication, division, logical operations, floating point number and arithmetic operations with floating point numbers.

Linear select memory organization, decoders, dimensions of memory access, connecting memory chip to a computer bus, bipolar IC memories, statics MOS memories, dynamic memories, magnetic core storage, information in magnetic core storage in a two dimensional array, assembly of core planes into a core memory, H-ring sequence, driving X and Y selection lines, memory buffer register and associated circuitry, core memory organization and wiring schemes, magnetic drum storage, parallel and serial operation of a magnetic drum, floppy disk, tape cassettes and cartridges, digital recording techniques, return to zero, return to bias, non return to zero recording techniques.

Review of output devices like printers, CRT, keyboards, terminals, interfacing buses, interfacing a keyboard, program control of keyboard interfaces, interfacing a printer, interrupts in input-output systems, a standard bus interface.

Construction of instruction word, instruction cycle and execution cycle organization of control registers, sequence of operation of control registers, controlling arithmetic operations, typical sequence of operations, BRANCH, SKIP or JUMP instructions, SHIFT instructions, instructions word formats, representation of instructions and data, addressing techniques, direct addressing, immediate addressing, paging, relative addressing, indirect addressing.

Large computers of single chip microcomputers, microprocessor architecture and instruction execution, architecture of a typical CPU, instruction execution, internal architecture of Intel 80854 CPU, bit slice architecture.

Microcomputer organization, basic components of a microcomputer, interconnecting components in a microcomputer, memory addressing mode, input and output techniques, some other microcomputer components, multiple processor architecture.

I/O techniques, I/O communication with devices outside the microcomputer, I/O handshaking control, I/O timing, I/O buffering and latches and FIFO, program controlled I/O, interrupt controlled I/O, LSI I/O parts, serial I/O UARTS/ USARTS and their interfacing to microprocessor systems.

Basic principles of analog interfacing, digital to analog conversion, analog to digital conversion, interrupts, interrupt recognition, interrupt response and interrupt vectors,

vectored interruption, interrupt priority, interrupt structure of 80854, LSI interrupt controllers, pro and cons of interrupt driven systems,

Assembly language programming using 8085A, organization of 8085, data transfer group arithmetic group, logical group, branch group, stack, I/O and machine control group unannounced OP codes of the 8035A, basic assemble directives, decimal floating point arithmetic with 8085A. Study of systems like Z-80, A386, 80486.

Recommended Books

1. T.C. Bartee, Digital Computer Fundamentals, McGraw Hill International Book, 1981.
2. S.K. Bose, Digital Systems, New Age International, 1997.
3. V. Rajaraman and T. Radhakrishnan, An Introduction to Digital Computer Design, Printice Hall of India, 1982.
4. R.S. Gaonkar, Microprocessor Architecture, Programming and Applications with 8085/ 8080A, Willey Eastern, 1986.
5. B.B. Brey, Inter Micro processors, PHI, 1999.

VEER MARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part - II

PHYSICS

List of Experiment

Group I

1. To design, build and test a two stage R.C. coupled amplifier.
2. To design, build and test a wide-band amplifier.
3. To design, build and test a bistable multivibrator.
4. To design, build and test a mono-stable multivibrator.
5. To design, build and test Schmitt Trigger circuit.
6. To design, build and test wein bridge oscillator using IC 741.
7. Voltage to frequency converter using ICs.
8. Operational amplifier applications: voltage regulator, function generator.
9. Study of phase modulation.
10. Study of frequency shift keying.
11. Study of phase-locked loops.
12. To design, build and test adder and subtractor.
13. To design, build and test analog to digital converter.
14. To design, build and test digital to analog converter.
15. 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.
16. To design, build and test a ROM using diode matrix for BCD to seven segment code conversion for 7-segment LED display and study 74147/74148 IC.
17. To design, build and test (i) 4 line to 1 line multiplexer (ii) 1 line to 4 line demultiplexer.
18. To design, build and test (i) a 4 bit binary up counter 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.
19. To design, build and test (i) 4 bit serial input, parallel output left/ right shift register using JK flip-flops and its modification using D-flip-flops (ii) study of the tristate PIPO registers.
20. To design, the basic RAM memory cell and its conversion to (i) 4 x 1 RAM and (ii) 1 x 4 RAM.
21. Electronic construction technique (Circuit layout and printed circuit technique).

22. To design, build and test Colpitt's oscillator.
23. To design, build and test band pass filter.
24. To design, build and test square wave operator using logarithmic amplifier.
25. Write and execute a programme to (i) enter two digit number through key board (ii) convert it to hex number and (iii) display the result..
26. Writing and testing the following assembly language programmes.
 - (i) Arrange the data stored in some location in ascending/ descending order.
 - (ii) Multiplication.
 - (iii) Multiple precision addition and subtraction.
 - (iv) Switch
 - (v) LED (to light L E D, to flicker LED)
 - (vi) sending and reading data serially and sorting it using I/O devices.
27. Music generation by generating appropriate RS232 (signals by 8085 and getting music on a loud speaker)
28. Setting up a fiber optic analog and digital links.
29. Study of time division multiplexing.
30. Study of PCM voice coding and code chip.
31. Study of divergence of a laser beam (Laser Kit).
32. Measurement of speed of light (Laser Kit).

Group:B

List of Experiments

3 hours/ week.

1. Interpolation and inverse interpolation using Lagrange's formula.
2. Numerical integration using Simpson's rules.
3. Solving a system of linear equations using matrix inversion.
4. Writing and testing computer programmes (FORTRAN and C) for experiments 1 - 3.
5. Determination of plateau for Geiger tube.
6. Determination of half life of a radioactive source.
7. Gamma ray spectrometer.

The evaluation of group-B experiments will be through regularly submitted laboratory reports as a part of internal assessment. The total marks for internal assessment for Group-A (test + laboratory reports) and Group-B (laboratory reports) will be 60.

Recommended Books

1. H.B. Dave, Laboratory Experiments in Digital Systems, Mcmillan (India), 1977.
2. B.S. Sonde, Introduction to system design using integrated circuits, New Age International, 1998.

VEER MARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part - II

PHYSICS

Group - II

Paper – II

Theoretical Physics

Independent particle model, ground state and excited states of two electron atoms, central field approximation, Thomas-Fermi model, Hartree and Hartree-Fock method and self consistent field, L-S, J-J Coupling, corrections to central field-approximation, Born-Oppenheimer method, He^+ ion, Hydrogen Molecule.

Quantization of radiation, spontaneous emission, quantum theory of dispersion, scattering of light, Raman scattering.

Dirac-hydrogen atom, non-relativistic second order perturbation calculation of Lamb shift, Lamb Rutherford experiment.

Scattering by complex potential, complex K and I planes, Regge trajectories, analytic properties of scattering amplitude, Brownian motion, Langevin equations, random walk problem, diffusion, Einstein relation for mobility, power spectrum of fluctuations, persistence and correlations of fluctuations, Johnson and shot noise, saha ionization formula, Molecular weight distribution in linear condensation polymers, size distribution of polymer molecules, rubber elasticity, helix-coil transitions in polymers, Method of second quantization (non-relativistic) introduction to quantum field theory, K G field, electromagnetic interactions, covariant perturbation theory, Feynman graphs and its applications, higher order corrections, renormalization in electrodynamics.

Unitary symmetry, Lie algebra of $\text{SU}(2)$, fundamental representation, $\text{SU}(2)$ representation, applications, unitary symmetry in three dimensions, Lie algebra of $\text{U}(n)$, $\text{SU}(n)$ representation of $\text{SU}(3)$, Abelian transformation, electrodynamics of a Dirac field, spontaneous symmetry breaking, non-Abelian transformation, standard model and Quantum Chromodynamics.

Recommended Books

1. G.Baym, Lectures on Quantum Mechanics Addison-Wesley, 1982.
2. H.A. Bethe and R. Jackiew, Intermediate Quantum Mechanics, Addison Wesley, 1986.
3. B.K. Agarwal and H. Prakash, Quantum Mechanics, PHI, 1997.
4. M.P. Khanna, Introduction to particle physics, PHI, 1999.
5. E.S.R. Gopal, statistical mechanics and Properties of matter, McMillan, India, 1962.
6. C. Itzykson and J.B. Zuber, Quantum Field Theory, McGraw Hill, 1980.
7. L.H. Ryder, Quantum Field Theories, Cambridge University Press, 1985.
8. B.K. Agarwal, Quantum Mechanics and Field Theory, Asia, 1976.

VEER MARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part - II

PHYSICS

Group - II

Paper III

Computer Applications in Physics

Introduction to computer hardware software, stored program concept, computer operating systems, UNIX, DOS, LINUX and their uses.

Essentials of parallel computation, FORTAN 90 and its features for parallel programming.

Use of scientific packages (i) to solve problems in physics (ii) to model simple physical systems.

Programming examples to study the following numerical methods to investigate problems in physics:

Cubic splines and rational functions interpolation, least squares techniques. Eigenvalue computations, location of bound, largest eigen value.

Richardson's extrapolation.

Rombers integration.

Integration of improper integrals and integrals over infinite range.

Fast Fourier Transform, Laplace transform with application to differential equation.

Boundary value problems, Monte Carlo method and its applications.

Simulative molecular dynamics, computer model of an accelerating car, modeling of radioactive decay, Monte Carlo simulations, Lanzos algorithm and many body problems and other simulation problems.

Recommended Books

1. P.S. Grover, programming and computing with FORTAN 77-90, allied publishers, 1990.
2. V. Rajaraman and C. Siva Rammurthy, Parallel Computer, 2000.
3. R.N. Reddy and C.A. Ziegler, FORTAN 77, Jaico Book, 1989.
4. S.C. Chabra, R.P. Canale, Numerical methods for Engineers, McGraw Hill, 1989.
5. M.L. Dejong, Introduction to computative physics, Addison Wesley, 1977.
6. T.Pang, An introduction to computational physics, Cambridge Uni. Press, 1971.
7. H. Gould and Tobochnik, An Introduction to computer simulation methods, vols. 1-2, Addison Wesley, 1988.
8. S.E. Koonin, Computational Physics, Addison Wesley, 1986.
9. G.I. Duchi, spreadsheet Applications for scientists and Engineers, Addison-Wesley, 1988.

VEER MARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part - II

PHYSICS

Laboratory work (Group II)

The total marks for practicals and project work will be 140. 70 marks will be for project work. Each student shall submit 2 copies of his/ her project work. 70 marks will be for two experiments at the University examination.

I Group A List of Experiment 6 hours/ week

1. Interpolation and inverse interpolation with unequal intervals of arguments using Newton's divided difference formula.
2. Solving a system of simultaneous equations using Newton-Rapson method.
3. Obtaining characteristics roots, characteristics vectors of a square matrix.
4. Solving ordinary differential equations.
5. Numerical integration using Gauss quadrature.
6. Writing and testing computer programmes for experiments no.1-5 (FORTAN and C)
7. Numerical simulation of simple harmonic oscillator, anharmonic oscillator.
8. Numerical solution of orbit.
9. Numerical simulation of projectile.
10. Numerical solution of Laplace's equation.
11. Numerical algorithm and solution of Shrodinger equation.
12. Use of spreadsheet for solving physics problems.
13. Multidimensional Monte Carlo intergration.

Group B List of Experiment 3 hours/ week

1. Determination of Platean of Geiger tube.
2. Determination of half life of radioactive source.
3. Gamma ray spectrometer.

II Project work (Contact hours included in Group A)

The evaluation of Group B experiments will be through regularly submitted laboratory reports as a part of internal assessment. The total marks for internal evaluation for group A (test + laboratory reports) and group B (laboratory reports) will be 60.

VEER MARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part - II

PHYSICS

Group III

Paper II

Materials Science - I

Materials and civilization, structure properties performance, classification of materials, states of matter, theory of liquids, transition between states of matter, energetics of transitions, structure of solids, crystallization, three dimensional bonding, interatomic distances, generalization based on bonding, formation of amorphous solids, metallic glasses, colloidal state of matter, gels, emulsions, liquid crystals, plasma state of matter, advanced materials, modern materials needs.

Phase diagrams, definition and basic concepts, Gibb's phase rule, one component and two component phase diagrams, phase in organic polymers, properties of phases in materials, crystalline and non-crystalline phases, practical aspects of phase diagram, non-equilibrium in phase diagrams, iron carbon alloy, ceramic systems, composite materials.

Elastic and plastic behaviour of materials, viscous and viscoelastic deformation, character of plastic flow, deformation of crystalline materials, applications of plastic deformation, test of mechanical properties, creep fracture, fatigue, hardness, principle of fracture mechanisms, environmental effects for fatigue, variability of material properties, design/safety factors.

Magnetic properties, antiferromagnetism, ferrimagnetism, influence of temperature on magnetic behaviour, soft and hard magnetic materials, magnetic storage, magnetic bubbles.

Optical properties of metals and non-metals, optical materials, luminescence excitation and emission, decay mechanisms, thallium activated alkali halides, electroluminescence.

Phase deformation in materials, nucleation, growth of nuclei, solidification of alloys, common phase transformations in solid materials, description of overall transformations, isothermal transformations in steel, polymorphic transformations, hardening and tempering of steel, precipitation hardening, other strengthening mechanics.

Metals and alloys, alloy steels, tool steels, cast irons, wrought iron, non-ferrous metal alloys, metals for high temperature service, composite materials, agglomerated materials, surface modifications, reinforced materials, wood.

Spontaneous and stimulated emission, population inversion, methods of population inversion, laser action, laser rate equation for three level systems, different types of lasers, fiber optics, fibre optics in communication, Amorphous materials.

Recommended Books

1. A.G. Guy, Essentials of materials science, McGraw Hill, 1976.
2. Manas Ghande, Science of Engineering Materials, Vols. 1-3, McMillan (India), 1980.
3. L.H. Vanvleck, Elements of Materials Science and Engineering, Addison Wesley, 1999.
4. W.D. Callister, Materials Science and Engineering, John Wiley, 1997.
5. A.J. Dekker, Solid State Physics, McMillan (India), 1982.
6. W.G. Maffat, G. W. Pearsale and J. Walf, The Structure and properties of materials Vols. 1-4. Wiley Eastern, 1988.
7. C.M. Srivastava and C. Srinivasan, Science of engineering materials, New Age International, 1997.

VEER MARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part - II

PHYSICS

Group - III

Paper – III

Materials Science – II

Ceramics, Crystal structure, silicate ceramics, ceramic crystals, imperfections in ceramics, carbon, glass Ceramics, electric and magnetic properties of ceramics and metals, abrasive ceramics, advanced ceramics, ceramic compounds.

Polymer molecules, molecular lengths and molecular weight of polymers, definitions of resin and plastic, characteristics and applications of plastics, Polymerization process, designing polymer structure for improved properties, miscellaneous applications, advanced polymer materials, dielectric and optical properties of ceramics and polymers, ionic conduction in ceramics and polymers, transparent materials, ferrites for microwave, applications of dielectric materials, electrets.

Semiconductor processing, light emitting solids, monoscale materials, advanced materials and processes for next two decades, materials selection and design considerations, case studies, automobile valve storing, thermal protection system on space shuttle orbiter, materials for integrated circuit packages, Economics, environmental and social issues in materials science and engineering.

Point defects in solids, lattice vacancies, interstitial diffusion in metals, self diffusion in metals, colour centres, F centres, other centres in alkali halides, photoconductivity in crystals containing excess metals, colour centres produced by irradiation with x-rays, production of x-ray, x-ray tubes, filters, Laue method, rotating and oscillating crystal method, Weissenberg method, method for powder crystals, measurement of lattice parameter, determination of crystal structure, single crystal technique, Fourier computational methods, techniques and applications of neutron diffraction, comparison of neutron and X-ray diffraction.

Vacuum techniques, units of pressure measurement, characteristics of vacuum, applications of vacuum, vacuum system, vacuum pumps, vacuum gauges, pumping speed of a vacuum system, thin film techniques, thin film production methods, thickness monitor, film thickness measurement, optical, electrical and galvanometric properties of thin films, ellipsometry and its applications, super-conductivity in thin films, Applications of thin films, antireflection coating, transistors, computer memory devices, thin Solar cells, thin microelectronics, thin film transducers, different methods of growing crystals, (melt, solution, vapour, hydrothermal synthesis etc) whiskers, needles, dendrites.

Transmission and scanning electron microscopy, environmental scanning electron microscope, applications of scanning electron microscopy.

Non-destructive testing, basic test methods, leakage testing, penetrant method, magnetic methods, ultrasonic testing, radiography and applications, eddy current methods. Use of radioactive isotopes in non-destructive testing, recent developments in non-destructive testing, holography, Mossbauer effects etc.

Recommended Books

1. W.D. Callister, *Materials Science and Engineering*, Wiley, 1997.
2. M. Sayer and A. Mansingh, *Measurement, instrumentation and experimental design for physics and engineering* PHI, 2000.
3. L.H. Vanvleck, *Elements of materials science and Engineering*, John Wiley, 1997.
4. W.G. Moffat, G.W. Pearsale and J. Walff, *The Structure and properties of materials* vols. 1-4, Wiley Eastern, 1958.
5. S. Dushman and J. H. Lafferty, *Scientific Foundations Vacuum techniques*, Wiley, 1962.
6. R.A. Landise, *The Growth of Single crystal*, Prentice Hall, 1979.
7. P. Hertyman, *Crystal Growth*, Elsevier, 1973.
8. M.J. Buerger, *Crystal Structure Analysis*, John Wiley, 1960.
9. P.J. Grandy and G.A. Jones, *Electron microscopy in study of materials*, Edward Arnold, 1976.
10. J.H. Lambie, *Principles and practice of NDT*, Herwood, 1962.
11. R. Hamshaw, *Non-destructing Testing*, Edward Arnold, 1987.
12. C.M. Srivastava and C. Srinivasan, *Science of Engineering materials*, New Age, International, 1997.

VEER MARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

M.Sc. Part - II

PHYSICS

Laboratory Work

(Group - III)

Total marks for practicals and project will be 200. 70 marks will be for project work. Each student shall submit 2 copies of his/her project report. 70 marks will be for two experiments at the University examination.

I – Groups – A	List of Experiments	6 hours / week
-----------------------	----------------------------	-----------------------

1. Growing single crystals (from solution melt, etc.)
2. Study of defects in crystals.
3. Stereographic projection of crystal models.
4. ESR Spectrometer.
5. Curie temperature of novel metal.
6. Measurement of dielectric constant of ferroelectric materials.
7. Measurement of magnetic susceptibility of materials.
8. Study of properties of thin films.
9. Preparation of thin film.
10. Ultrasonic method of studying materials.
11. Ellipsometer.
12. Properties of polymers.
13. Luminescence and decay law.
14. Study of divergence of a laser beam (laser kit)
15. Measurement of speed of light (Laser kit).
16. Study of light pipes and fiber optics (Laser kit).
17. Setting up of a fiber optic analog link.

Groups – B	List of Experiments	3 hours / week
-------------------	----------------------------	-----------------------

1. Interpolation and inverse interpolation using Lagrange formula
2. Numerical integration using Simpson's rules
3. Solving a system of linear equations using matrix inversion.
4. Writing and testing computer programmes (FORTRAN and C).
5. Determination of Plateau of Geiger tube.
6. Measurement of half life of a radioactive source.
7. Gamma ray spectrometer

II – Project Work : (Contact hours included in Group-A)

The evaluation of group – B experiments will be through regularly submitted laboratory reports as a part of internal assessment. The total marks for internal assessment for Group-A.

(test + laboratory report) and Group B (laboratory reports) will be 60.