ગુજરાત યુનિવર્સિટી

એકેડેમિક/બી/૬૦૪૦૨/૨૦૦૬ તા.૨૩/૬/૨૦૦૬

પરિપત્ર : ૨૫

ગુજરાત યુનિવર્સિટી સંલગ્ન ભૌતિક વિજ્ઞાન વિભાગના વડાશ્રીને કુલપતિશ્રીના આદેશાનુસાર જણાવવાનું કે M.Sc. Physics Part-IIનો અભ્યાસક્રમ સુધારવામાં આવે છે જે પરિશિષ્ટ તરીકે આ સાથે સામેલ છે. તેનો અમલ જૂન-૨૦૦૬ થી કરવાનો રહેશે.

આપનો વિશ્વાસુ,

કુલસચિવ

બિડાણ : ઉપર મુજબ

પ્રતિ,

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GUJARAT UNIVERSITY

M.Sc. PHYSICS PART II
(Effective from June, 2006)

Paper I

Nuclear Physics, Quantum Mechanics & Numerical Methods

UNIT - I

Nuclear Properties : Nuclear spin, electric moments, magnetic moments, a brief description of hyperfine structure of atomic spectra, effect of an external magnetic field on the hyperfine structure, determination of I from molecular band spectra, molecular beam resonance method – experiments on hydrogen and deuteron.

Two-body forces: Deuteron. Excited states of the deuteron, neutron proton scattering at low energies, scattering length, spin dependence of neutron proton scattering, singlet state in n-p system, effective range theory in n p scattering, tensor forces, magnetic moment and electric quadrupole moment of the deuteron, proton proton scattering at low energy, exchange forces, meson theory of nuclear forces.

UNIT – II

Nuclear reactions : Nuclear reactions and cross sections, Resonance : Breit Wigner dispersion formula for l=0, the compound nucleus, continuum theory of nuclear reaction, Direct reactions, theory of stripping reactions : semi classical description.

Model : Single particle shell model, spin-orbit potential, analysis of shell model predictions –spins and parities of nuclear ground states; magnetic moments, electric quadrupole moment, stripping reactions and shell model. Collective nuclear model – rotational states and vibrational states.

Particle Physics : Classification of elementary particles, types of interaction, Baryon number, lepton number, parity, charge conjugation and Time reversal, CPT theorem, charge independence of nuclear forces, Isospin, consequences of isospin invariance. G-parity, strange particles, associated production, strangeness, Gell Mann-Nishijima scheme. Neutral K-meson, strangeness oscillations. Isospin and Su(2), flavor Su(3), Baryon and meson multiplets, GellMann-Okubo mass formula for octet, quark model, flavor and color force. A brief introduction to electroweak unification and grand unification.

UNIT – III

Scattering theory : Kinematics of the scattering process : differential and total cross sections elastic and inelastic scattering, wave mechanical picture of scattering : the scattering amplitude, Green's functions : formal expression for scattering amplitude. The Born approximation, validity of the Born approximation, The Eikonal approximation, Asymptotic behavior of partial waves : phase shifts, The scattering amplitude in terms of phase shift, The differential and total cross sections : optical theorem, Phase shifts : Relation to the potential, Potentials of finite range, Low energy scattering : S-wave resonance, physical explanation and Ramsauer-Towmsand effect, scattering by square well potential, by hard sphere and by coulomb potential.

Angular Momentum : Eigen value spectrum, Matrix representation of J in the $|jm\rangle$ basis, Spin angular momentum, Non relativistic Hamiltonian with spin, addition of angular momenta, Clebsch-Gordan Coefficients (no derivation), Spin wave functions for a system of two spin 1/2 particles, Identical particles with spin, addition of spin and orbital angular momenta, Spherical tensors ; Tensor operators, Wigner-Eckart theorem.

UNIT - IV

Relativistic wave Equations : Generalization of Schrodinger equation - Klein - Gordan equation : Plane wave solutions; - Charge and Current densities - Interaction with electromagnetic fields; Hydrogen-like atom, -Non relativistic limit - The Dirac equation : Dirac's Relativistic Hamiltonian – Position Probability density; expectation values - Dirac matrices - Plane wave splution : Energy spectrum - The Spin of the Dirac particle - Significance of negative energy states. – Relativistic electron in a central potential : Total angular momentum - Radial wave equation – Series solutions of the radial equation : asymptotic behavior - Determination of the energy levels –Spin magnetic moment - Spin-orbit energy.

Elements of Field quantization : Introduction - Lagrangian field theory - Non relativistic fields - Relativistic fields : Klein-Gordon field and Dirac field, A brief introduction to Feynman diagrams and QED Feynman graph rules.

UNIT – V

Solutions of simultaneous algebraic equations :
Solution of liner simultaneous equations, Direct methods of solution : Matrix inversion method, Gauss elimination method, Gauss-Jordan method, factorization method
Iterative methods of solution : Jacobi's method, Gauss-Seidal method, Relaxation method
Ill-conditioned equations
Solution of non-linear simultaneous equations

Eigen value problem :
Eigen values and Eigen vectors using Jacobi's method

Empirical laws and curve fitting :
Introduction, graphical method, laws of reducible to the linear law, method of group average, laws containing three constants, principle of least squares, method of least squares, fitting of other curves, method of moments

Numerical solution of partial differential equations:
Introduction, classification of second ordered equations, finite difference approximations to partial derivatives, elliptical equations, solution of Laplace equation, solution of Poisson's equation, parabolic equations, solution of one-dimensional heat equation, hyperbolic equations, solution of wave equations.

Reference Books :

1. Enge H. A., Introduction to Nuclear Physics
2. Roy R. R. and B. P. Nigam, Nuclear Physics theory and experiment
3. Tayal D. C., Nuclear Physics
4. Patel S. B., Nuclear Physics - an introduction
5. Fayyazuddin & Rizuddin, A modern introduction to Particle Physics,
6. Leon M., Particle Physics - an introduction
7. Perkins D. H., Introduction to High Energy Physics
8. David C. Cheng and Gerard K. O. Neill, Elementary Particle Physics - an introduction
9. A. Lahiri & P.B. Pal, A first book of quantum theory.
10. Mathews & Venketesan, A Text Book of Quantum Mechanics, TMH, 1976
11. Thankappan V. K., Quantum Mechanics
12. Grewal B.S., Numerical methods in engineering and science, Khanna publications

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M.Sc. PHYSICS PART II
(Effective from June, 2006)

Paper II
Electronics I

UNIT - I

Power Supply and Regulators : Regulators using differential amplifier and OPAMP as an error amplifier. IC Regulators using 723, 78XX, LM-317. Displays : LED (seven segment), dotmatrix, plasma, LCD.

MOSFET and other applications of FETs : The depletion MOSFET, The enhancement MOSFET, the difference between JFET and MOSFET. Handling precautions for MOSFET. Dual-Gate MOSFETs, Application of a Dual Gate MOSFET in an AGC amplifier, application of the FET in its channel ohmic region.

UNIT - II

The Operational Amplifier & Applications : Frequency compensation, the slew rate voltage to current converter, current to voltage converter, Bridge amplifier, Electronic Analog computation, active filters, comparators, sample and hold circuits, precision AC-DC converters, Logarithmic & antilogarithmic amplifiers, regenerative comparator, sine, square & triangular wave generators.

PLL : Basic PLL operation, Lock range and capture range, PLL as AM and FM detector.

UNIT – III

Digital Electronics : Parity generators and checkers, read only memory programmable array logic.

Flip Flops : RS flip-flop, Clocked flip-flop, D flip-flop, Edge triggered D flip-flop Flip-flop switching time, JK flip-flop, JK Master-Slave flip-flop, Schmitt-Trigger.

Clocks & Timers : Clock waveform, TTL clock, 555 Timer (internal block diagram) as Monostable Multivibrator and as Astable Multivibrator.

Shift Registers : Types of registers, serial in - serial out, serial in - parallel out, parallel in - serial out, parallel in - parallel out, ring counter.

Counters : Concept of asynchronous counters (IC 7493 Binary counter, IC 7490 Decade counter), Concept of synchronous counters (IC 74193-4-bit updown counter) Digital clock.

UNIT - IV

D/A and A/D Conversion : Variable register network, Binary ladder, D/A converter, D/A accuracy and resolution, A/D converter - simultaneous conversion, counter method, continuous A/D conversion, A/D techniques, Dual slope A/D conversion, A/D accuracy and resolution, application of DAC & ADC.

Microprocessor : Microprocessors, Microprocessor instruction set and computer languages from large computers to single-chip Microcontrollers. Microprocessor Architecture and its operations, memory, input and output devices, example of a microcomputer system. The 8085 MPU, example of 8085 based microcomputer. The 8085 programming model, instruction classification. Instruction format, How to write, assemble and execute a simple program.

UNIT – V

Overview of the 8085 instruction set. Data transfer (copy) operations, Arithmetic operations, Logic operations, Branch operations, Assembly language programs. Debugging a program,

Programming techniques : Looping, counting and indexing, additional data transfer and 16-Bit arithmetic instructions, Arithmetic operations related to memory.

Logic Operations : Rotate, compare, Dynamic debugging. Counters and time delays, illustrative program ; Hexadecimal counter, Illustrative program : Zero to Nine (modulo Ten) counter. Illustrative program : Generating pulse waveforms, debugging counters and time delay programs. Stack, subroutine, conditional call and return instructions, advanced subroutine concepts. BCD-to-binary conversion, Binary-to-BCD conversion, BCD-to- seven segment LED code conversion, BCD addition, BCD subtraction, Introduction to advanced instructions and applications, Multiplication, Substraction with carry.

Reference Books :

1. Botkar K. R., Integrated circuits, Khanna Publishers
2. Robert Boylested and Louis Nashelsky, Electronic Devices and Circuit Theory, PHI. (Third edition)
3. Muhammed Rashid, Power Electronics, PHI, IInd Edition
4. Sen P. C. , Power Electronics, TMH
5. Allen Mottershead, Electronic Devices and Circuits - An Introduction, PHI
6. Jacob Millmand and Christor C. Halkias, Integrated Electronics : Analog & Digital Circuits and Systems, TMH , 1991.
7. Albert Paul Melvino and Donald P. Leach, Digital Principles and Applications, TMH, Fourth edition
8. John D. Ryder, Electronic Fundamentals and Applications : Integrated and Discrete Systems, PHI, Fifth edition.
9. Gaonkar R. S., Microprocessor, Architecture, Programming and Applications with the 8085, Wiley Eastern Limited
10. Mukhopadhaya A. K., Microprocessor, Microcomputer & their Applications, NAROSA
11. Ram B., Fundamentals of Microprocessors & Microcomputers, Dhanpat Rai & Sons.
12. Anand Kumar, Fundamentals of Digital Circuits, PHI
13. Morris Mano, Digital Logic and Computer Design, PHI
14. Ramakant Gaiekwad, OPAMP & Linear Integrated Circuits, PHI

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M.Sc. PHYSICS Part II
(Effective from June, 2006)

Paper III
Electronics II

UNIT - I

Transmission Lines : Line parameters, inductance and capacitance of transmission (without derivation), a line of cascaded T sections, the transmission line - the general solution, physical significance of the equations, the infinite line, wavelength and velocity of propagation, reflection on a line not terminated in Zo, reflection coefficient, open and short circuited lines, parameters of the open wire line and coaxial line at HF, constants for line of zero dissipation, voltage and current on the dissipationless line, standing waves, nodes and SWR. The quarter wave line - impedance matching, single-stub impedance matching, Smith chart.

Wave Guides : Maxwell's equations for rectangular waveguides, transverse magnetic waves in rectangular waveguide and transverse electric waves in rectangular waveguide, cutoff and guide wavelengths, phase and group velocities, wave impedance, power transmission and power losses in waveguide, excitation of waveguide, Circular waveguides.

UNIT - II

Microwave Devices : Klystrons, Magnetrons and Traveling wave tubes, Veloc modulation, Basic principle of two cavity klystrons and Reflex Klystrons, principles of operation of magnetrons, helix traveling wave tube wave modes, transferred electron devices, Gunn effect, principle of operation, modes of operation of Gunn diode, Impatt diode.

Microwave Passive Circuit Components and Measurements : Attenuators, E-plane tee, H-plane tee and hybrid tee, directional couplers, isolator and circulators, Detection of
microwaves, microwave power measurement, measurement of impedance and frequency.

UNIT – III

Antenna : Basic antenna parameters (radiation pattern, radiation resistance, directivity and gain), Half-wave dipole antenna, effect of ground on the radiation pattern of ungrounded antenna, antenna arrays, Yagi antenna, antenna system employing parabolic reflectors, frequency independent log-parabolic antenna.

Radio Wave Propagation : Propagation of waves, Ground waves, Space wave propagation : atmospheric effects on space wave propagation, troposcatter propagation, General picture of the ionosphere, effect on wave propagation, refraction and reflection of sky waves, ray path, skip distance and MUF, multiple-hop transmission, relation between oblique and vertical incidence, ionospheric variations, sky wave signal strength, propagation characteristics of radio waves of different frequencies, extraterrestrial communication.

UNIT – IV

Modulation :
Single side band modulation : Introduction, single sideband principle, FET balanced modulator, SSB generation: Filter method, Phasing method, and Third method.

Angle Modulation : Theory of frequency and phase modulation, frequency spectrum of FM wave.

FM Generators : Reactance Modulator, Varactor diode Modulator, Armstrong method of frequency modulation, Pre-emphasis and De-emphasis networks.

FM Demodulators : Slope detector, Stagger tuned detector, Foster-Seeley discriminator, Ratio detector.

Pulse Modulation : Pulse amplitude modulation, Pulse code modulation : Quantization, Compression, PCM Receiver, Differential PCM, Delta modulation, Sigma-Delta A/D conversion, Pulse frequency modulation, Pulse time modulation, Pulse position modulation, Pulse width modulation.

Digital Communication : Synchronization, Asynchronous transmission probability of bit error in baseband transmission, matched filter, optimum terminal filters, Bit-timing recovery, Eye-diagrams, Digital carrier systems, carrier recovery systems, Hard and soft decision decoders.
Digital modulation techniques : ASK, FSK, CPFSK, MSK, PSK, BPSK, QPSK, DPSK.

UNIT -V

Radio receivers : Superheterodyne AM receiver, block diagram, RF section, mage frequency and its rejection, mixer & local oscillator section, IF section, letection and automatic gain control

Radar : Radar system, basic principles, fundamentals, radar performance factors, pulse system, Basic pulse Radar system, Antennas and scanning. Display methods, pulse radar systems, Moving target indicator (MTI), Radar beacon, CW Doppler radar, FM CW radar.

Satellite communication : Kepler's laws, orbits, geostationary orbit, power systems, attitude control, station keeping, antenna look angles, limits of visibility, frequency plan and polarization, transponders, uplink power budget calculations, downlink power budget calculations, overall budget calculations, digital carrier transmission, multiple access methods, applications of satellite communication, Indian National Satellite.

Reference Books :

1. J. D. Ryder, Networks, Lines and Fields, Prentice Hall of India Pvt. Ltd. New Delhi, 1991
2. E. C. Jordan and K. G. Balman, Electromagnetic waves and radiating systems, Prentice Hall of India, New Delhi, 1976
3. S. Y. Liao, Microwave devices and circuits, Prentice Hall, 1995
4. M. Kulkarni, Microwave and Radar Engineering, Umesh Publication Delhi, 1998
5. K. C. Gupta, Microwave, Wiley Eastern Ltd.. 1985
6. D. C. Sarkar, Microwave propagation and techniques, S. Chand and Company, New Delhi, 1990
7. R. E. Collins, Antennas and Radio wave propagation, McGraw Hill Book Company, 1987
8. M. L. Gupta, Electronic and Radio engineering, Dhanpat Rai & Sons, 1991
9. G. Kennedy, Electronic Communication system Tata M. Graw Hill, 1996
10. J. P. Agrawal and V. P. Arora. Essentials, Electronics, Kedar Nath Ram Nath Pub. 1989
11. D. Roddy and J. Coolen, Electronic Communication, Prentice Hall, 4th edition, 1995
12. N. D. Deshpande et al communication Electronics, McGarw Hill, New Delhi,
13. S. L. Gupta and V. Kumar, Hand Book of Electronics, Pragati Parkashan, 1998
14. Advanced Electronic Communication system by Wayne Tosmasi PHI Edition
15. Simon Haykin, Communication systems, John Wiley and Sons Inc, 1994 (Third edition).

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M.Sc. Part II—PHYSICS

List of Experiments

1. Design a voltage regulated power supply using IC 723

2. Determine guide wavelength in a rectangular waveguide at microwave frequency and compare it with calculated value.

3. Design an inverting amplifier of gain 10 using IC 741 and study its frequency response.

4. Study of amplitude modulation and demodulation using OMEGA-ETTB-96 trainer kit.

5. Determination of dielectric constant of a given substance at X-band microwave frequency.

6. Study of Schmitt Trigger circuit using OPAMP IC 741.

7. Study of integrating and differentiating circuits using OPAMP IC 741

8. Construct and study astable multivibrator using IC 741

9. Construct and study phase shift oscillator using IC 741

10. Design and construct astable and monostable multivibrator using IC 555.

11. Construct various types of flip-flops (S-R, J-K and D) and verify their truth table.

12. Study various types of shift registers and design ring counter using IC7495.

13. Study of decade counter and divide-by-six counter using IC 7490 and varification of truth table.

14. Writing and execution of programs using microprocessor trainer kit.
15. Writing and execution of programs using microprocessor trainer kit
16. Study of analog –to-digital conversion using ADC IC 0800

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