Gujarat University

M. Sc. (Physics) Semester - IV

(Effective from – 2017-2018)

Course	Name of the Course	Lect. Hrs. / Week	Internal Marks	External Marks	Total Marks	Course Credits
PHY-507	Nuclear Physics-II Advance Quantum Mechanics-II	**4**	**30**	**70**	**100**	**4**
PHY-508	Numerical Techniques and C-programming	**4**	**30**	**70**	**100**	**4**
PHY-509	Microprocessor-II and Microwaves	**4**	**30**	**70**	**100**	**4**
PHY-510	Electronic Communication-II	**4**	**30**	**70**	**100**	**4**
PHY-511PR	Practicals	**6**	**30**	**70**	**100**	**4**
PHY-512PT	Project	**6**	**30**	**70**	**100**	**4**
TOTAL		**28**	**180**	**420**	**600**	**24**

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PHY-507: Nuclear Physics-II and Quantum Mechanics-II

In this paper the different types of nuclear reactions, particle physics along with this the angular momentum and relativistic wave equation can be studied.

UNIT – I: Nuclear reactions and Nuclear Models

Nuclear reactions : Nuclear reactions and cross sections, Resonance : Breit Wigner dispersion formula for 1=0, the compound nucleus, continuum theory of nuclear reaction, Direct reactions, theory of stripping reactions - semi classical description and wave mechanical 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, nuclear isomerism, stripping reactions and shell model, Collective nuclear model – rotational states and vibrational states, a brief description of Nilson model.

UNIT-II: 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, CP-violation in K^o decay. Isospin and Su(2), Su(3), Baryon and meson multiplets, Gell Mann Okabo mass formula, quark model, flavor and color.

UNIT-III: Angular Momentum

Eigen value spectrum, Matrix representation of J in the |jm> basis, Spin angular momentum, Non relativistic Hamiltonian with spin, addition of angular momenta, Clebsch-Gordan Coefficients, 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, Projection theorem for a first rank tensor.

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.

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. Khanna M. P., Introduction to particle physics, PHI
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. Gasiorowicz S., Elementary particle Physics
10. Mathews & Venketesan, A Text Book of Quantum Mechanics, TMH, 1976
11. V. K.Thankappan, Quantum Mechanics

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PHY-508: Numerical Techniques and C-programming

Study of numerical techniques is essential to solve the problems of physical systems. The empirical laws and curve fittings techniques are very essential for analyzing experimental observations.
To provide basic concepts on advanced topics of c-programming such as structures, pointers and file management and to study how to write programs with various logics using the above concepts.
To write programs for various numerical methods commonly used in physics problems

Unit - I: Solution of Simultaneous equations
Consistency of a system of linear equations, System of linear homogeneous equations, Solution of linear simultaneous equations, Matrix inversion method, Gauss elimination method, Gauss-Jordan method, Factorization method, Jacobi's iterative method, Gauss-Seidal iterative method, Relaxation method, Ill-conditioned equation, Iterative method to improve accuracy of an ill-conditioned system, Solution of non-linear simultaneous equations by Newton-Raphson method.

Unit - II: Empirical laws and Curve fitting
Introduction, Graphical method, Laws reducible to the linear law, Method of group averages, Laws containing three constants, Principle of least squares, Method of least squares, Fitting of other curves, Method of moments.

Unit - III: C- Programming language
Structures and Unions: Structure definition, giving values to members, structure initialization, arrays of structures, arrays within structures, structures within structures, structures and functions, Unions, size of structures.
Pointers: Concept, accessing the address of variables, declaring and initializing pointers, accessing variables through pointers, pointer expressions, pointer increments and scale factor, pointers and arrays, pointer and character strings, pointers and functions, pointers and structures
File management in C: Defining, opening and closing a file, I/O operations on files, error handling during I/O operations, random access to files.

Unit - IV: Programming of Numerical methods
Solution of polynomial equations: Bisection method, Newton Raphson Method, Numerical Integration: Trepizoidal method, Simpsons's method, Monte Carlo method, Solutions of simultaneous algebraic equations : Gauss Seidal method, Solution of ordinary differential equations : Ranga-Kutta method.

Reference books:

1. Numerical Methods in Engineering and Science, S. Grewal and J. S. Grewal, Khanna Publishers, New Delhi (2002)
2. Numerical Methods, E. Balgurusamy, TMGH Pub. Co. Ltd, New Delhi (2000)
3. Numerical Methods with Computer Programs in C++, Pallab Ghosh, PHI, New Delhi (2006)
4. Programming in ANSI C (IIInd Ed.), E. Balgurusamy, TMGH Pub. Co. Ltd, New Delhi (2004)
5. Programming in C, P. Day and M. Ghosh, Oxford Univ. Press, New Delhi (2007)
6. Programming with C, B. S. Gottfried, TMGH Pub. Co. Ltd, New Delhi (2000)
7. Let us C, Y. Kenetker, BPB Pub., New Delhi (1999)
8. C Programming language, B. W. Kernighan and D. K. Ritchie, PHI, New Delhi (1999)
9. Computer Oriented Numerical Methods, V. Rajaraman, PHI, New Delhi

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PHY-509: Microprocessor-II and Microwaves

Software (instructions) is an integral part of microprocessor and demands emphasis equal to that of hardware. The main objective of Microprocessor II is to familiarization with 8085 instructions, programming techniques, program development systems. Students can learn themselves assembly language programming and debugging techniques

To develop, in the students of this course, a good understanding of the operation, properties and behavior of some of the microwave components – topics on active as well as passive microwave components have been included in two units of this paper. Topics on measurement techniques of some parameters like the microwave power, frequency and impedance are also included in one of these units. This will give some idea about microwave measurement techniques to the students.

UNIT -I

Introduction to 8085 instructions: Data transfer (copy) operations, Examples, Addressing Modes, Illustrative program: Data transfer-From Register to Output Port, How to enter and execute a program, Illustrative program: Data transfer to control output devices, Arithmetic Operations. Addition, subtraction, Examples, Flag concepts and cautions, subtraction of two unsigned numbers, Review of important concepts**,** Logical operations; OR, Exclusive-OR and NOT, Data Masking with logic AND, Examples, ORing data from two input ports, Branch Operations, Unconditional jump, Unconditional jump to set up a continuous loop conditional jumps, Testing of a Carry flag Writing Assembly language program: Microprocessor controlled Manufacture Process,

Programming Techniques with Additional Instructions: Programming Techniques; Looping, Counting and Indexing, conditional loop, counter, Examples, Additional Data transfer and 16-bit Arithmetic instructions, 16-bit data transfer to Registers pairs (LXI), Data transfer from Memory to Microprocessor, Examples, Data transfer from the Microprocessor to Memory or directly into Memory, Arithmetic operations related to 16-bits (Register Pairs), Illustrative program: Block transfer of Data bytes, Arithmetic Operations related to Memory, Examples, Illustrative program: Addition with Carry, Logic operations: Rotate-Left, Right with and without carry, Applications of Rotate instructions, Illustrative program: Checking sign with Rotate instructions,

UNIT – II

Counters and Time delay: Counter, Time delay- using one Register, a Register pair, a loop within loop technique, Delay calculations, Additional techniques, Counter design with time delay, Hexadecimal zero to nine (Modulo ten_ Counters, Illustrative program: Generating pulse wave forms, Debugging counter and time delay programs.

Stack and Subroutine: Concepts of Stack and Subroutine, Examples, Illustrative programs: Resetting and displaying flags, Traffic Signal Controller, Multiple calling of a subroutine Restart, Conditional call and Return instructions, Advance subroutine concepts: Nesting, Multiple ending subroutines, Similarities and differences between CALL-RET, PUSH-POP instructions.

Code Conversion, BCD Arithmetic and 16-bit data operations: BCD to binary conversion, Illustrative program: 2-digit BCD to binary conversion, binary to BCD conversion, Illustrative program: binary to unpacked BCD conversion, BCD to seven segment LED code conversion, BCD to-common cathode- LED code conversion, Binary to ASCII Hex code conversion, ASCII Hex code to Binary conversion, BCD addition, Addition of Unsigned BXS numbers, BXD subtraction, subtraction of two packed BCD numbers, Advanced instructions, 16-bit data Transfer and Data exchange group, Example, Arithmetic group. Instructions related to the stack Pointer and program Counter, Miscellaneous instruction Multiplication: Multiplication of Two 8-bit unsigned numbers, Subtraction with Carry, 16-bit subtraction, Review of instructions and Applications.

UNIT -III

Microwave Devices : Klystrons, Magnetrons and Traveling wave tubes, Velocity 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.

UNIT -IV

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.

Reference Books:

1. Ramesh Gaonkar, **Microprocessor Architecture, Programming and Applications with 8085 (fifth edition),** Penram International Publishing (India) Private LTD.

2. S. Y. Liao, **Microwave devices and circuits**, Prentice Hall, 1995

3. M. Kulkarni, **Microwave and Radar Engineering**, Umesh Publication Delhi, 1998
4. K. C. Gupta, **Microwave**, Wiley Eastern Ltd.. 1985
5. D. C. Sarkar, **Microwave propagation and techniques**, S. Chand and Company, New Delhi, 1990
6. G. Kennedy**, Electronic Communication system** Tata M. Graw Hill, 1996
7. D. Roddy and J. Coolen, **Electronic Communication**, Prentice Hall, 4th edition, 1995

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PHY-510: Electronic Communication -II

The transmission line theory bridges the gap between field analysis and basic circuit theory. The phenomenon of wave propagation on transmission lines is approached from an extension of circuit theory as well as from a specialization of Maxwell's equation. Analysis of transmission line will be undertaken. Students will be introduced with the various antenna parameters and the basic operating principles of antennas. They will also learn about the different types of the antennas that are commonly used. To acquaint the students with the basic super heterodyne system, the preferred design for most receivers. This will be done for receivers corresponding to the two modulation schemes namely AM and FM that they have studied so far. Students of this course will be made familiar with a system called RADAR, which uses these circuit elements as building blocks. By studying this unit students will know about the operation and properties of the various types of the radar systems which have a large number of civilian as well as military applications.

UNIT –I: Transmission Line Theory

Lumped element circuit model for a transmission line, Field analysis of transmission lines, The terminated lossless transmission line, Smith chart. The quarter wave transformer, Generator and load mismatches, Lossy transmission lines.

UNIT –II: 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.

UNIT –III: Radio receivers

Super heterodyne AM receiver, block diagram, RF section, image frequency and its rejection, mixer & local oscillator section, IF section, detection and automatic gain control, Noise in AM receiver. FM receivers, Common circuits-comparison with AM receivers, Noise in FM receiver

UNIT-IV: Radar

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

Reference books:

1. David M. Pozar, Microwave Engineering (Third Edition), Wiley- India.
2. J. D. Ryder, Networks, Lines and Fields, Prentice Hall of India Pvt. Ltd. New Delhi, 1991
3. G.P.Srivastava, V.L.Gupta, Microwave Devices and Circuit Design, PHI.
4. G.S.Raghuvanshi, Microwave Engineering, CENGAGE Learning.
5. E. C. Jordan and K. G. Balman, Electromagnetic waves and radiating systems, Prentice Hall of India, New Delhi, 1976
6. M. Kulkarni, Microwave and Radar Engineering, Umesh Publication Delhi, 1998
7. D. C. Sarkar, Microwave propagation and techniques, S. Chand and Company, New Delhi, 1990.
8. R. E. Collins, Antennas and Radio wave propagation, McGraw Hill Book Company, 1987
9. M. L. Gupta, Electronic and Radio engineering, Dhanpat Rai & Sons, 1991
10. G. Kennedy, Electronic Communication system, Tata M. Graw Hill, 1996
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,

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PHY– 511PR: PRACTICALS

LIST OF PRACTICALS:

1. Design and Study of Low pass filter Circuit using IC 741.
2. Design and Study high pass filter Circuit using IC 741.
3. Study of Amplitude Modulation and Demodulation using Trainer kit.
4. Study of Transmission Line characteristics using Trainer Kit.
5. Study of ADC using IC 0800.
6. Familiarization with Microprocessor 8085 Kit.
7. Writing & Execution of some simple Programs using Microprocessor 8085Kit.
8. Writing & Execution of some advanced Programs using Microprocessor 8085Kit.
9. Determination of dielectric constant of unknown sample at microwave frequency.
10. ExpEyes based Experiments
11. ExpEyes based Experiments
12. Experiments on optical fiber using kit

15% of new experiments can be introduced AND / OR replaced as per the need, with the permission of the Head.

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PHY– 512PT: PROJECT