Gujarat University

M. Sc. (Physics) Semester - III
(Effective from – 2017-2018)

Course	Name of the Course	Lect. Hrs. / Week	Internal Marks	External Marks	Total Marks	Course Credits
PHY-501	Nuclear Physics-I, Advanced Quantum Mechanics-I and Instrumentation	**4**	**30**	**70**	**100**	**4**
PHY-502	Numerical Methods and Analog Electronics	**4**	**30**	**70**	**100**	**4**
PHY-503	Digital Electronics & Microprocessor-I	**4**	**30**	**70**	**100**	**4**
PHY-504	Electronic Communication-I	**4**	**30**	**70**	**100**	**4**
PHY-505PR	Practicals	**6**	**30**	**70**	**100**	**4**
PHY-506PT	Project	**6**	**30**	**70**	**100**	**4**
TOTAL		**28**	**180**	**420**	**600**	**24**

GUJARAT UNIVERSITY
M. Sc. (PHYSICS) SEMESTER – III
(EFFECTIVE FROM – 2017-2018)

PHY-501: Nuclear Physics-I, Advanced Quantum Mechanics-I and Instrumentation

In this we are studying the Nuclear properties, like electric moment, magnetic moments etc., Two body problems of deuteron. In scattering theory born-approximation and complex potential and absorption are studied along with this the essential experimental techniques for physical sciences are covered.

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.

UNIT-II: 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 – 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 Born series, 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, scattering by a square well potential, scattering by a hard sphere, scattering by a coulomb potential, Complex potential and absorption.

UNIT-IV: Transducers, Measurement and control

Transducers: Desired characteristics of transducer, Different transducers: Temperature, Capacitive, Magnetic field, LVDT, Optical, Piezoelectric, Pyrometer. Measurement and control: Types of noises in electrical systems, Signal to noise ratio, Enhancement of signal to noise ratio, Signal conditioning and recovery, Impedance matching, filtering and noise reduction, shielding and grounding, Phase sensitive detector and lock-in amplifier.

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. T.P.Holmann., Experimental systems, Applications and Design : TMH publication.
11. M.Sayer & A Mansingh., Measurement, Instrumentation and experimental design for physicists and engineers: Prentice Hall of India
12. Mathews & Venketesan, A Text Book of Quantum Mechanics, TMH
13. V. K.Thankappan, Quantum Mechanics

GUJARAT UNIVERSITY
M. Sc. (PHYSICS) SEMESTER – III
(EFFECTIVE FROM – 2017-2018)

PHY-502: Numerical Methods and Analog Electronics

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. It is very necessary to give course on analog electronics before digital electronics and hence this paper is designed to study power supply, regulators and amplifiers.

Unit-I: Numerical Solution of Ordinary Differential Equations

Introduction, Picard's method, Taylor's series method, Euler's method, Modified Euler's method, Runge's method, Runga-Kutta method, Predictor-corrector method, Milne's method, Adams-Bashforth method.

Unit-II: Numerical Solution of Partial Differential Equations

Introduction, Classification of second order equations, Elliptical equations, Solution of Laplace equation, Solution of Poisson's equation, Parabolic equations, Solution of one-dimensional heat equation, Solution of two dimensional heat equation, Hyperbolic equations, Solution of wave equation.

UNIT-III: Power Supply and Regulators

IC Regulators using 723, Positive, Negative, Low and High voltage regulators, current booster transistor, fold back current limiting circuit.

The Operational Amplifier & Applications : active filters, low pass, high pass, band pass, band reject, notch, first and second order filters, comparators, sample and hold circuits, Logarithmic & antilogarithmic amplifiers.

UNIT-IV: Tuned & Wide Band Amplifiers

The pole-zero diagram, single tuned amplifier-root locus, inductively coupled circuits, tuned primary amplifiers, tuned secondary FET amplifier, the double tuned transformer, stagger tuned amplifiers, response to pulses, bandwidth requirement for pulse amplification, rise time in pulse amplifier, sag of the pulse, shunt peak video amplifier. Rise time at the shunt peaked amplifier.

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

Reference books:

1. Numerical Methods in Engineering and Science
   B. S. Grewal and J. S. Grewal, Khanna Publishers, New Delhi (2002)
2. Numerical Methods
   E. Balgurusamy, Tata McGraw-Hill Publishing Company Limited, New Delhi (2000)
3. Numerical Methods with Computer Programs in C++
   Pallab Ghosh, Prentice-Hall of India Private Limited, New Delhi (2006)
4. Integrated circuits,
   K. R. Botkar, Khanna Publishers
5. Electronic Devices and Circuit Theory,
   Robert Boylested and Louis Nashelsky, PHI. (Third edition)
6. Electronic Fundamentals and Applications: Integrated and Discrete Systems, John D. Ryder, PHI, Fifth edition.
7. OPAMP & Linear Integrated Circuits, Ramakant Gaiekwad, PHI

GUJARAT UNIVERSITY
M. Sc. (PHYSICS) SEMESTER – III
(EFFECTIVE FROM – 2017-2018)
PHY-503: DIGITAL ELECTRONICS & MICROPROCESSOR – I

Digital electronics is a very important area of electronics. Digital circuits, memories, clocks, timers and counters are taught in detail. ADC and DAC techniques for digitization of signals are included. Microprocessor is the basic block of modern computers. Architecture, instruction sets and writing of simple programmes is detailed here.

UNIT– I: Digital Electronics

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

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 – II: 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,
Displays: LED (seven segment), dot matrix, plasma, LCD.

UNIT-III: Microprocessor- based systems: Hardware and interfacing

A programmable machine: device, Memory, Input/output, CPU. Block diagram of a Microcontroller, Advances in semiconductor Technology, Organization of Microprocessor-Based system. Microprocessor Instruction set and computer languages: Machine Language: 8085 Machine language, 8085 Assembly language. ASCII code, writing and Executing Assembly language program, High level languages, Block diagram of Translation High level language into Machine code, operating system. From large computer to Single chip Microcontrollers: Large Computers, Medium size computers, Microcomputers, personal computers, workstations, single board Microcomputers, Single chip Microcomputers (Microcontrollers)

Application: Microprocessor controlled Temperature system (MCTS): System hardware, Microprocessor-controlled Temperature system (MCTS) block diagram, Microprocessor, Memory, input (A/D converter) Temperature sensor, output including Fan, Header, LCDs, system software (Programs)

Introduction to 8085 Assembly Language Programming: The 8085 Programming Model Hardware Model, Programming model: Registers, Accumulator, Flags, Program Counter (PC) and Stack Pointer (SP)

Instruction classification: The 8085 instruction set, Data transfer operations, Arithmetic operations, logical operations, Branching Operations, Machine control operations and Review.

Instruction, Data format and Storage: Instruction Work size: one byte, two byte, Three byte, Opcode format, Data format: ASCII Code, BCD code, Signed integer, Unsigned integers, Instruction and data storage: Memory.

How to write Assemble and execute a simple program: Illustrative program: Addition of two hexadecimal numbers, including Flow chart, Manual assembly process and executing a program. Writing and hand assembling a program: Illustrative program: Subtracting two hexadecimal numbers and storing the result in Memory, writing Mnemonics, and Assembling Hex code, common errors.

UNIT- IV: Microprocessor Architecture and Microcomputer Systems

Microprocessor Architecture and Its Operations, Memory : Flip-Flop or Latch as a storage Element, Memory Map and Addresses, Examples, Memory Address Range of a 1K Memory chip, Memory Address Lines, Memory work size, Memory and Instruction Fetch, Memory classification: From static Memory to Flash Memory, Advances in Memory technology.

Input and output (I/O) devices: I/Os with 8-bit Addresses (Peripheral-Mapped I/O), I/O with 16-bit Addresses (Memory-Mapped I/O)

Logic devices for interfacing: Tri-state devices, Buffer, Examples of Tri-state buffer. Bidirectional buffer, octal buffer, Logic diagram and Function Table, Decoder, (2 to 4), (3 to 8), Examples of Decoders, Encoder (8 to3), D-Flip-Flops: Latch and clocked; Examples of Latches (Registers), Logic diagram and Function Table.

8085 Microprocessor, Architecture and Memory interfacing: The 8085 MPU : The 8085 Microprocessor, Address bus, The 8085 Microprocessor pin out and signals, Multiplexed Address/data bus, Control and status signals, power supply and clock frequency, Externally initiated signals, Microprocessor communication and Bus timings, Examples of Data flow from Memory to MPU, Timing diagram, De-multiplexing the bus AD_7-AD_0, Generating control signals, A detail look at the 8085 MPU and its Architecture, The 8085A Microprocessor: Functional block diagram Example of Instruction decoding and execution, Example of an 8085-based Microcomputer: 8085 single-Board Microcomputer system, The 8085 Machine cycles and Bus timing, Op-code Fetch Machine cycle, Memory read Machine cycle with example and Timing diagram, How to recognize machine cycle.

Reference books:

1. Digital Principles and Applications
   Albert Paul Malvino , Donald P. Leach and Saha , Tata McGraw-Hill Publishing Company Limited, New Delhi
2. Fundamentals of Digital Circuits
   Anand Kumar, Prentice-Hall of India Private Limited, New Delhi (2006)
3. Digital Logic and Computer Design
   Morris Mano, , Prentice-Hall of India Private Limited, New Delhi (2006)
4. Microprocessor Architecture, Programming and Applications with 8085
   Ramesh S. Gaonkar, Penram International Publishing India Private LTD. (Fifth edition)
5. Microprocessor, Microcomputer & their Applications, A.K Mukhopadhaya ,NAROSA Publisher.
6. Fundamentals of Microprocessors & Microcomputers, B. Ram ,Dhanpat Rai & Sons.

GUJARAT UNIVERSITY
M. Sc. (PHYSICS) SEMESTER – III
(EFFECTIVE FROM – 2017-2018)

PHY- 504: Electronic Communication – I

Electronic communication is a very important area of electronics. Various techniques of modulation and different aspects of digital communication are included in this paper. Radio wave propagation is an important aspect of long distance communication; different modes of radio wave propagation are covered in this paper. Satellite communication and optical fiber communication which revolutionized the communication systems are also covered this paper.

Unit - I: Radio Wave Propagation and Satellite communication

Radio Wave Propagation: Propagation in free space - mode of propagation, microwave systems. Tropospheric Propagation - mode of propagation, radio horizon, super and sub refractions, attenuation in atmosphere, VHF/UHF radio system. Ionospheric propagation - ionospheric layers, effect of ionosphere on wave propagation, plasma frequency and critical frequency, secant law skip distance and MUF, optimum working frequency, virtual height, effect of earth's magnetic field, service range, ionospheric irregularities and disturbances, HF radio systems. Surface wave – mode of propagation, ground wave.

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

Unit – II: Fiber optic Communication

Principle of light transmission in a fiber - propagation with in a fiber, fiber index profiles, Modes of propagation - overview of modes, key modal concepts, Maxwell's equations, waveguide equations for cylindrical fiber, wave equations for step index fiber, modal equation, modes in step index fiber, single mode fiber. Losses in fibers - absorption losses, leaky modes, mode coupling losses, bending losses, combined fiber losses. Dispersion - effect of dispersion on pulse transmission, intermodal dispersion, material (chromatic) dispersion, total dispersion and maximum transmission rates. Light sources and detectors for fiber optics. optical receiver circuit. Connectors and splices - losses in connectors and splices, connectors, fiber splices. Fiber optic communication link.

Unit - III: Analog Modulation

Amplitude modulation: Theory of amplitude modulation, Frequency spectrum of AM wave, AM modulator and detector.

Single side band modulation: 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. Reactance FM Modulator, Armstrong method of frequency modulation. Slope detector, Stagger tuned detector, Foster-Seeley discriminator, Ratio detector.

Unit - IV: Pulse Modulation and Digital Communication:

Pulse Modulation: Pulse amplitude modulation, Pulse code modulation, PCM Receiver, Pulse time modulation, Pulse position modulation, Pulse width modulation.

Synchronization, Probability of bit error in baseband transmission, matched filter, Bit-timing recovery, carrier recovery systems.

Digital carrier systems: Amplitude Shift Keying(ASK),Frequency Shift Keying(FSK), Continuous Phase Frequency Shift Keying(CPFSK),Minimum Shift Keying(MSK),Phase Shift Keying(PSK).

Reference books:

1. Roddy D. and Cooln J., Electronic communications, PHI, 2006
2. Kennedy G and Davis B. Electronic Communication systems, TMH 1999.
3. Tosmasi W., Advanced Electronic Communication system, PHI.
4. Keiser G, Optical fiber communications, MGH, 2000
5. Senior J.M., Optical Fiber Communications – Principles and practice, Pearson, 2007
6. Roddy D., Satellite communications, M.L. Gupta , Electronic and Radio engineering Dhanpat Rai & Sons, 1991

M. SC. (PHYSICS) SEMESTER - III
(EFFECTIVE FROM – 2017-2018)

PHY– 505PR: PRACTICALS

LIST OF PRACTICALS:

1. Design and Study of Astable Multivibrator using IC 741
2. Design and Study of Phase Shift Oscillator using IC 741
3. Design and Study of Voltage Regulated Power Supply using IC 723
4. Design and Study of Schmitt Trigger using IC 741.
5. Design and Study of Astable & Monostable Multivibrator using IC 555.
6. Design and Study of Two Stage Amplifier using ICs 741.
7. Design and Study of different types of Flip-Flops using IC 7400,7402 & 7473.
8. Study of different types of Shift Registers using IC 7493.
9. Design and study of decade counter and divide by six counter using IC 7490.
10. Determination of Guide Wavelength of a rectangular wave guide.
11. Study of PLL characteristics(IC 565).
12. ExpEyes based Experiments

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

M. SC. (PHYSICS) SEMESTER - III
(EFFECTIVE FROM – 2017-2018)

PHY– 506PT: PROJECT