Scheme for M.Sc. Physics NEP 2020

For 2 Year PG programme

First Year

Scheme for M.Sc. Physics NEP 2020

For 2 Year PG programme

Scheme sem-1: (For the course of science having major practicum components)

M.Sc. Physics I Semester

S.No	Course Code	Course Name	Total Mark	Credit (s)	End Semester Exam Marks		Internal Marks	
					Max	Min.	Max	Min.
1.	MPY2-511	Mathematical Physics	100	6	60	24	40	16
2.	MPY2-512	Classical Mechanics	100	6	60	24	40	16
3.	MPY2-513	Practical - I	100	4	60	24	40	16
4.	MPY2-514	Practical – II	100	4	60	24	40	16
5.	MPY2-515	Internship/Seminar/Field Project	100	2	-	-	100	40
		Grand Total	500	22				

BRANCH	Subject	Subject Code
M.Sc. (Physics)	**Mathematical Physics**	**MPY2-511**

Course learning outcomes (CLO):-

On successful completion of this course, the students will be able to:

1. Understand the early life, education, and historical context of Aryabhata and Bhaskaracharya II.

2. Develop a strong foundation in mathematical methods such as curvilinear coordinates, probability, group theory, special functions, complex analysis and tensor.

3. Apply mathematical techniques to solve physics problems, translating real-world situations into mathematical formulations.

4. Solve quantitative problems by applying mathematical models to predict or analyse physical behaviour.

Unit - I

Curvilinear Coordinates, probability and Group theory

1. A brief biography of Aryabhata and Bhaskaracharya II with their major contribution to science and society.

2. Introduction to Curvilinear Coordinates, Orthogonal curvilinear coordinates, differential of an arc length, differential operators, spherical and cylindrical coordinates and their unit vectors.

3. Elementary probability theory, Conditional Probability, Bayes theorem, random variables, binomial, Poisson and normal distributions. Central limit theorem.

4. Group theory: Introductory group theory, Special unitary group of degree two SU(2), Special orthogonal group of degree three SO(3).

Unit – II

Special Functions

1. Legendre function: Legendre's equation, Legendre's polynomial and its generating function, Recurrence formula, General solution of Legendre equation, Rodrigue's formula, Orthogonality of Legendre Polynomials.
2. Bessel functions: Bessel equation and its solution, Bessel functions Jn(x), Recurrence formula and generating function, Orthogonality of Bessel function.
3. Hermite's Function: Hermite's equation, Generating function of Hermite polynomials, Orthogonal property of Hermite polynomials, Recurrence formula for Hn(x) of Hermite equation.

Unit – III

Complex Analysis

1. Introduction to Complex Numbers and their Graphical Representation, Functions of Complex Variables, Analyticity of complex function, Cauchy- Riemann equation,

2. Singularities: poles, removable singularity, essential singularity, branch points, Cauchy theorem, Cauchy integral formula, Laurent and Taylor's expansion. Residues and Residue Theorem. Application of Contour Integration in solving Definite Integrals.

Unit – IV

Fourier and Laplace transform:

1. **Fourier:**FourierTransforms, Integrals Transforms, Fourier Integral theorem (Statement only),Fourier sine and cosine transform, Fourier transform of single pulse, trigonometric, exponential functions, Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem, Properties of Fourier transforms.
2. **Laplace:**Laplacetransforms, Laplace transform of Elementary functions, Properties of Laplace transforms, Change of Scale Theorem, Shifting Theorem, Laplace transforms of derivatives, Derivatives and Integrals of Laplace transforms, Laplace transform of Unit Step functionand Periodic Functions, Convolution Theorem, Inverse Laplace transforms, Solution of heat flow along semi-infinite bar using Laplace transform.

Unit – V

Tensor Analysis

1. Tensors- Notations and Conversions, Contravarient tensors, Rank of the Tensors
2. Properties of the Tensors e.g. Addition, Subtraction and Product , Contraction, Cartesian tensors and their transformation properties

Eigen values of second rank tensors, Quotient law, Higher Rank Tensors with examples from piezoelectricity, stiffness and compliance.

BRANCH	Subject	Subject Code
M.Sc. (Physics)	**Classical Mechanics**	**MPY2-512**

Course learning outcomes (CLO):-

On successful completion of this course, the students will be able to:

1. Understand the historical background and contributions of C.V. Raman and Meghnad Saha.

2. Formulate Lagrange's and Hamilton's equations of motion and understand their applications.

3. Apply the variational principle and principle of least action to solve physical problems.

4. Define and apply canonical transformations and generating functions.

5. Analyze small oscillations and determine normal modes of vibration.

6. Understand the motion of rigid bodies.

Unit - I

Lagrangian and Hamiltonian Dynamics

1. Historical background and contributions of C.V. Raman (regarding study of elastic vibrations, wave mechanics), Meghnad Saha ionization equation (statistical mechanics, thermodynamics – classical roots).
2. Newtonian mechanics of a system of particles, Constraints and their classification, Generalized coordinates, Principle of virtual work, D'Alembert's Principle in generalized coordinates, Langrange's equation from D- Alembert principle, Generalized Potential, Lagrangian for a charged particle moving in EM field, Application: Single particle in Space, Simple pendulum, Atwood's machine, Bead sliding on rotating wire.
3. Generalized momentum and cyclic coordinates, Hamiltonian function and conservation of energy, Hamilon's equations, Hamilon's equations in different coordinate systems.

Unit – II

Central forces and Variational principles

1. Variational principle, Euler-Lagrange's equation from variational principle, Applications: shortest distance between two points and Brachistochrone problem, Deduction of Hamilton principle from D- Alembert principle, Lagrange's equations of motion for Non-Holonomic system and Lagrange's Multipliers, Principle of least action.

Unit – III

Canonical transformation and Brackets

1. Canonical Transformation, Legendre transformation, Generating functions, Application of canonical transformation.
2. Poisson's Brackets and their properties, Lagrange Brackets and their properties, Invariance of Poisson's Bracket with respect to canonical transformation, Jacobi's

Identity, Phase space and Liouville's Theorem.

Unit – IV

Hamilton- Jacobi formulation and Small oscillation

1. Hamilton- Jacobi equation, Solution by Hamilton- Jacobi method: Harmonic oscillator, Kepler's Problem, Action and angle variables.
2. One-dimensional oscillator, Two coupled oscillators, Normal Coordinates and Normal Modes, Kinetic and potential energy in normal coordinates, General theory of small oscillation, Secular equation and Eigen value equation,

Unit – V

Non-inertial systems

1. Euler's angles, Infinitesimal rotations as vectors (Angular velocity), Angular Momentum and Inertia tensor.
2. Euler's equations of motion for a rigid body, Torque- free motion of a rigid body, Motion of a heavy Symmetrical top, Gyroscope.
3. Non-inertial Frame of reference, Fictitious Force, Uniformly rotating frames, Coriolis force, Free fall of a body on Earth's Surface.

BRANCH	Subject	Subject Code
M.Sc. (Physics)	**Practical - I**	**MPY2-513**

Course learning outcomes (CLO):-

On successful completion of course, students will be able to:

1. Determine the value of Rydberg's constants.
2. Calculate energy loss per cycle (hysteresis).
3. Measure variation of resistivity with temperature.
4. Compare self Inductance of two coils.

Calculate the thermoelectric voltage vs temperature.

List of Practical

1. Determine the value of Rydberg's constants with the diffraction grating and hydrogen tube.
2. To determine the hysteresis loss of a given transformer by CRO.
3. To find the maximum power and efficiency of a solar cell.
4. Study the temperature dependence of resistivity of a semiconductor and to determine the band gap of the material.
5. To verify Fresnel's formula for the reflection of light
6. To compare Self-inductance of two coils L1 and L3 with Maxwell Bridge.
7. To determine the frequency of an electric tuning fork by Melde's experiment and verify $\lambda 2$–T law.
8. Determination of Lande's 'g' factor of paramagnetic materials using electron spin resonance method.
9. To determine the self inductance of a coil by Anderson bridge.
10. Study of different thermocouples for temperature measurement.

BRANCH	Subject	Subject Code
M.Sc. (Physics)	**Practical - II**	**MPY2-514**

Course learning outcomes (CLO):-

On successful completion of course, students will be able to:

1.Understand basic principles of optics.

2.Analyze dispersion phenomena and evaluate the refractive index variation using Cauchy's dispersion formula.

3. Understand the behaviour of light through optical setups, such as prisms, wedges, and interferometers.

4. Understand the phenomena of photoelectric effect and blackbody radiation.

5. Identify Explore rotational spectrum of iodine vapor.

List of Practical

1. To calibrate of drum of constant deviation spectrograph.
2. To study the variation of refractive index of the material of prism with wavelength and Cauchy's dispersion formula.
3. To determine the wavelength of monochromatic light by diffraction at a straight edge.
4. To find out the wavelength of the given light source with the help of Michelson interferometer.
5. To determine the angle of a given wedge using given laser beam.
6. To determine the refractive index of water using hollow prism.
7. To determine the Plank's constant using Black Body Radiation and Photo- Detector.
8. To determine the absorption lines in the rotational spectrum of Iodine vapour.
9. Determination of Wavelength of different colours using LED.
10. Photo-electric effect: photo current versus intensity and wavelength of light.

BRANCH	Subject	Subject Code
M.Sc. (Physics)	**Internship/Seminar/Field Project**	MPY2-515

Project /Dissertation work (Six weeks) in the form of small thesis based upon the topic related to the M.Sc. Physics syllabus . The topics of the dissertation with synopsis will be decided by the

Departmental Research Advisory Committee (DRAC).

M.Sc. Physics II Semester

S.No	Course Code	Course Name	Total Mark	Credit (s)	End Semester Exam Marks		Internal Marks	
					Max	Min.	Max	Min.
1.	MPY2-521	Condensed Matter Physics	100	6	60	24	40	16
2.	MPY2-522	Advanced Quantum Mechanics	100	6	60	24	40	16
3.	MPY2-523	Practical - I	100	4	60	24	40	16
4.	MPY2-524	Practical – II	100	4	60	24	40	16
5.	MPY2-525	Value-added course (VAC) from /MOOCS, SWAYAM, NPTEL (Microbial Technology, Quality Control, Biosafety and Bioethics.	100	2	-	-	100	40
		Grand Total	500	22				

BRANCH	Subject	Subject Code
M.Sc. (Physics)	**Condensed Matter Physics**	**MPY2-521**

Course learning outcomes (CLO):-

On successful completion of this course, the students will be able to:

1. Understand the concept of Panchamahabhuta.

2. Analyze and classify crystal structures using point and space group symmetries.

3. Understand the Electronic and Thermal Properties of materials.

4. Describe the mechanical behavior of crystalline solids through stress-strain tensors.

5. Understand the phenomena of superconductivity and important effects such as Meissner effect and Josephson effect.

Unit - I

Crystallography

1. Indian philosophy on the five basic elements Panchamahabhuta.
2. Point and Space group, Crystal structures- Hexagonal closed packed, Diamond, cubic structure and Perovskite structures, Reciprocal lattice.
3. Brillouin Zone, X- ray diffraction, Bragg's law, Lau's equation, Reciprocal lattice vector.
4. Fourier analysis of the basis, Scattered wave amplitude, Structure and form factors.

Unit – II

Mechanical Properties

1. Mechanics of deformed bodies for cubic crystals, stress strain tensors, Compliance and stiffness constants.
2. Elastic constants and energy density of cubic crystals, elastic waves in crystals and elastic isotropy.

Lattice Dynamics

1. Normal modes of mono atomic and diatomic lattice vibrations, Dispersion relations, Phonon density of states.
2. Quantum theories of specific heats, An-harmonic effect, Equation of state of solid s, Thermal expansion, Gruneisen relation

Unit – III

Electronic and Thermal Properties

1. Sommerfeld free electron model, Density of states, Application of electronic specific heat, Wiedermann Franz Law, Boltzmann Transport equation.

2. Relaxation time approximation and application to electrical conductivity, Hall Effect.

Unit – IV

3D lattice vibrations

1. Vibration of three dimension lattice, coupling parameter approach in variance relations.
2. Phonon dispersion curves and its experimental method of determination. Neutron scattering

Unit – V

Superconductivity

Superconductivity characteristic features, Critical current, Persistent current and Meissner effect,Critical Magnetic fields, Magnetic Susceptibility, flux quantization, specific heat, Thermal conductivity,Isotope effect, Optical energy gap, Quasi particle tunneling and Josephson effects (d.c. & a.c.),Electron phonon interaction, cooper pairs, BCS theory, Type I and II superconductivity, Introduction to high temperature superconductivity.

BRANCH	Subject	Subject Code
M.Sc. (Physics)	**Advanced Quantum Mechanics**	**MPY2-522**

Course learning outcomes (CLO):-

On successful completion of this course, students will be able to understand:

1. The concept of vibrations and sound by vedic philosophy.
2. Hilbert space, operators as matrices and Dirac's BRA and KET notations.
3. Three - dimensional Schrödinger equation in terms of spherical coordinates and its applications.
4. Quantum theory of scattering and scattering amplitude.
5. Different approximation methods and their applications.

Unit - I

Review and formulation of Quantum Mechanics

1. The concept of "Nada Brahma" from Vedic philosophy and its significance in the Indian Knowledge System.
2. Introduction of Schrodinger wave equation and wave function, linear vector space, time dependent and time independent vectors, inner product, concept of Hilbert space.
3. Operators and wave functions as matrices, unitary transformation: change of basis, Dirac's BRA and KET notations and their properties.
4. Linear harmonic oscillator (solution by ladder or algebra method), energy eigenvalue, creation and annihilation operator, matrices for x and P_x.

Unit – II

Three - dimensional Schrödinger equation and Angular Momentum

1. Three - dimensional Schrödinger equation in terms of spherical coordinates, Applications for the determination of eigen functions and eigen values: (a) Rigid rotator (free axisand fixed plane), (b) Hydrogen atom.
2. Angular momentum operators and its representation in spherical coordinates, commutation relations, eigen values and eigen functions of Lz and L^2.
3. Ladder operators and eigen values, Spherical harmonics and its expressions, Spin angular momentum, Pauli's spin matrices.

Unit – III

Theory of Scattering

1. Scattering cross section, differential scattering cross section, total scattering cross section, scattering amplitude, relation between scattering cross section and scattering amplitude, quantum

theory of scattering.

2. Born Approximation, condition for the validity of Born approximation.
3. Method of partial waves analysis, optical theorem, phase shift, dependence of phase shift on potential, application: scattering by a perfectly rigid sphere.

Unit – IV

Approximation methods

1. Time-independent perturbation theory for non-degenerate and degenerate systems up to first and second order and its application for He-atom and Stark effect in hydrogen atom.
2. Variational (Rayleigh-Ritz) method and its application to the ground state He atom.
3. JWKB approximation, condition of validity, connection formulae, probabilityof penetration of a potential barrier.
4. Time dependent perturbation theory **(**Constant perturbation)..

Unit – V

Many -electron atoms and Schrödinger relativistic equation

1. The central field approximation, Thomas-Fermi statistical model, Hartree's method of self- consistent field.
2. Klein Gordon equations, probability and current density, Klein Gordon equation in electromagnetic field, Hydrogen atom, short comings of Klein Gordon equation.
3. Dirac's relativistic equation for free electron, Dirac's matrices, Dirac's equation in electromagnetic field, Hydrogen atom and hyperfine splitting, Negative energy.

BRANCH	Subject	Subject Code
M.Sc. (Physics)	**Practical - I**	**MPY2-523**

Course learning outcomes (CLO):-

On successful completion of this course, the students will be able to:

1. Understand the phonon dispersion in solids.

2. Analyze the V-I characteristics of semiconductor diodes.

3. Understand the characteristics of digital circuits including flip-flops, adders, and subtractors.

4. Determine type of charge carrier of semiconductors using Hall Effect.

5. Verify laws of Boolean algebra.

List of Practicals

1. Study of phonon dispersion curves of linear mono and diatomic lattice vibrations in crystal.
2. To study the V-I characteristics of a tunnel diode and to determine its negative resistance region.
3. Study of photoconductivity of cadmium sulphide (CdS) photo register at constant irradiation and voltage.
4. Identification of charge in P-type and N-type semiconductor using Hall effect.
5. Study of V-I characteristic curveof UJT and their use as relaxation oscillator.
6. Study of V-I characteristic curve of Gunn diode.
7. To verify De Morgan's theorem.
8. Verification of the truth tables of Half adder circuit.
9. Verification of the truth tables of Half subtractor circuit.
10. To verify laws of Boolean algebra.

BRANCH	Subject	Subject Code
M.Sc. (Physics)	**Practical - II**	**MPY2-524**

Course learning outcomes (CLO):-

On successful completion of course, students will be able to:

1. Calculate e/m ratio using Zeeman principle.

2. Determine Young's modulus and Poisson's ratio.

3. Explore optical dispersion and quantify refractive index variation using Cauchy's formula.

4. Determine Curie temperature and dielectric constants of ferromagnetic material.

5. Study the characteristics of thermistors.

List of Practical

1. Determination of e/m of electron by Zeeman principle using Febry Perot interferometer.
2. To determine Young's modulus and Poisson's ratio of a glass plate using Cornu's method of interference.
3. To study the variation of refractive index of the material of prism with wavelength and Cauchy's dispersion formula.
4. To determine dielectric constant and Curie temperature of ferromagnetic material (BaTiO3).
5. Study the characteristic curves of Thermistor.
6. Determination of Magnetic susceptibility of Paramagnetic solution by Quincke's method.
7. To generate a sinusoidal waveform using a function generator and measure its frequency and voltage amplitude using a Digital Storage Oscilloscope (DSO).
8. To determine the components of circuit using LCR meter.
9. Study of different thermocouples for temperature measurement.
10. To Compare the capacitances of two condensers by De-sauty's Bridge.

M.Sc. Physics III Semester

S.No	Course Code	Course Name	Total Mark	Credit (s)	End Semester Exam Marks		Internal Marks	
					Max	Min.	Max	Min.
1.	MPY2-531	Nuclear, Atomic and Molecular Physics	100	6	60	24	40	16
2.	MPY2-532	Material Science	100	6	60	24	40	16
3.	MPY2-533	Practical - I	100	4	60	24	40	16
4.	MPY2-534	Practical – II	100	4	60	24	40	16
5.	MPY2-535	Internship/Seminar/Field Project	100	2	-	-	100	40
		Grand Total	500	22				

BRANCH	Subject	Subject Code

M.Sc. (Physics)	Nuclear, Atomic and Molecular Physics	MPY2-531

Course learning outcomes (CLO):-

On successful completion of this course, the students will be able to:

1. Understand the historical background and contributions of renowned discoveries in Nuclear physics.

2. Understand the concepts of Nuclear Fission and Fusion

3. Understand the concepts Elementary particles

4. Understand atomic and molecular spectra, including selection rules for transitions.

5. Understand various spectroscopic methods.

Unit - I

Historical background and contributions of Dr. Vikram Sarabhai, Dr. Homi Jehangir Bhabha and Dr. Raja Ramanna in Nuclear physics and Atomic Theory of Vaiśeṣika
Concept of Nuclear Fission and Fusion, Liquid Drop, Shell and collective models of Nucleus, Scintillation and Solid-State Detectors, Cerenkov Detectors

Unit - II

Elementary particles,Classification of Particles, Interactions, Symmetries and Conservation laws, the quark model, Baryon and Lepton numbers, Iso-spin, hypercharge, Strangeness, Parity, Quark Model, Charm, Beauty and Truth.

Unit – III

LS coupling and JJ coupling schemes, Fine structure of hydrogen-like atoms, Hyperfine structure and isotope shifts, Selection rules for optical transitions, Zeeman effect: Normal and anomalous, Basics of ESR (Electron Spin Resonance) and NMR (Nuclear Magnetic Resonance)

Unit – IV

Born-Oppenheimer approximation, Electronic, vibrational, and rotational energy levels of molecules, Rotational spectra of diatomic molecules (rigid and non-rigid rotator models), Vibrational spectra (harmonic and anharmonic oscillators), Vibrational-Rotational spectra,Electronic spectra of diatomic molecules (Franck-Condon principle), Morse potential energy curve; Molecules as vibrating rotator; Vibration spectrum of diatomic molecule.

Unit – V

Raman Effect: Classical and quantum theories, Raman spectroscopy and its applications in determination of molecular structure,Molecular polarizability, Pure Vibrational and Rotaltional spectra of diatomic molecules, Experimental setup of Raman effect.

BRANCH	Subject	Subject Code
M.Sc. (Physics)	**Material Science**	**MPY2-532**

Course learning outcomes (CLO):-

On successful completion of this course, the students will be able to:

1. Understand the historical background of Indian Metallurgy.
2. Understand the phenomena of nuclear kinetics and diffusion.
3. Calculate the lattice parameters using XRD.
4. Understand the concepts and applications of Nanomaterials.
5. Utilize various tools and techniques to investigate microstructure of material.

Unit – I

Phase Transition:

Ancient Indian Metallurgy: Copper metallurgy, Ferrous metallurgy, Relative stability of phase and phase rule, Single component and binary phase diagrams, Microstructural changes during cooling, Lever rule. Order, Disorder Transition

Unit – II

Kinetics and Diffusion

Nucleation Kinetics, Growth and transformation Kinetics, Application in transformation in steel, solidification and crystal growth; Diffusion in solids, Fick's law, Solution to Fick's second law, Kirkendal effect.

Unit – III

X-Ray Diffraction

X-ray Diffraction process and Diffractometer, applications of XRD, Principle of powder diffraction method, Interpretation of XRD data, accurate determination of lattice parameters; least-square method (Rietveld Analysis)

Unit – IV

Nanomaterials

Basic concepts and applications, Types of Carbon based nanomaterials, Fullerenes, Carbon nanotubes, Single wall and multi- wall carbon tubes, Synthesis of carbon nanomaterials, Electronic and mechanical properties of nano-materials.

Unit – V

Microscopy Techniques

Microstructure of materials, Scanning and Transmission Electron Microscopy techniques, compositional analysis by energy dispersive spectroscopy; surface analysis by Scanning Tunneling and Atomic Force Microscopy

BRANCH	Subject	Subject Code
M.Sc. (Physics)	**Practical - I**	**MPY2-533**

Course learning outcomes (CLO):-

On completion of the course, the students will be able to:

1. Understand the quantum mechanical basis of spin and magnetic moments.
2. Understand the dependence of stopping potential on frequency of incident light.
3. Study monostable and astable multivibrator.
4. Study the line emission spectra.
5. Understand the principles of Phase shift Oscillator.

List of Practicals

1. To Study of ESR.
2. Measurement of stopping potential and determination of Planck's constant.
3. Determine e/m by helical method.
4. To study astable multivibrator.
5. Hall Effect Experiment to determine charge carrier concentration and mobility.
6. To study Monostable multivibrator.
7. Identification of unknown element from line emission spectra.
8. Determination of e/m of Electron by Thomson's Method.
9. To study Phase shift Oscillator.
10. To study Wein Bridge Oscillator.

BRANCH	Subject	Subject Code
M.Sc. (Physics)	**Practical - II**	**MPY2-534**

Course learning outcomes (CLO):-

On completion of the course, the students will be able to:

1. Understand concept of quantization of energy levels.
2. Understand temperature dependence of resistivity.
3. Understand the working principle of a GM counter.
4. Study dielectric constant of semiconductor materials.
5. Study of Splitting of Spectral Lines in magnetic field.

List of Practical

1. To experimentally demonstrate the concept of quantization of energy levels by Franck-Hertz Experiment.
2. To determine band gap by four probe method.
3. To determine the resistivity of semiconductors by Four probe Method.
4. Study of GM Counter.
5. Determining the plateau and optimal operating voltage of Geiger- Muller Counter.
6. To determine dielectric constant of Semiconductor material.
7. To determine the Hall voltage developed across the sample material.
8. Zeeman Effect – Study of Splitting of Spectral Lines.
9. To study of characteristics of SCR.
10. Study of characteristics of LDR.

BRANCH	Subject	Subject Code
M.Sc. (Physics)	**Internship/Seminar**	**MPY2-535**

Project /Dissertation work (Six weeks) in the form of small thesis based upon the topic related to the M.Sc. Physics syllabus . The topics of the dissertation with synopsis will be decided by the

Departmental Research Advisory Committee (DRAC).

M.Sc. Physics IV Semester

S.No	Course Code	Course Name	Total Mark	Credit (s)	End Semester Exam Marks		Internal Marks	
					Max	Min.	Max	Min.
1.	MPY2-541	Laser and Fiber Optical Communication	100	6	60	24	40	16
2.	MPY2-542	Digital Electronics and Microprocessor	100	6	60	24	40	16
3.	MPY2-543	Practical - I	100	4	60	24	40	16
4.	MPY2-544	Practical – II	100	4	60	24	40	16
5.	MPY2-545	Value-added course (VAC) from /MOOCS, SWAYAM, on quality control & assurance .	100	2	-	-	100	40
		Grand Total	500	22				

BRANCH	Subject	Subject Code
M.Sc. (Physics)	**Laser and Fiber Optical Communication**	MPY2-541

Course learning outcomes (CLO):-

On successful completion of this course, the students will be able to:

1. Concept of ancient Indian theory of light.

2. Learn about different types of lasers (e.g., He-Ne, Ruby, and Semiconductor) and their key characteristics.

3. Understand the Optical Fiber, its types and basic structure.

4. Study different optical fiber sources.

5. Understand fiber fabrication methods.

Unit – I

Conceptual Ancient Indian Understanding of Light (Tejas) and compare it to modern laser principles. Overviews on Indian Institutes of LASER and fiber optical communication. Introduction Characteristics (Monochromaticity, Directionality, Brightness, Coherence) of a LASER beam, Interaction of radiation with matter(Induced Absorption, Spontaneous Emission, Stimulated Emission), Einstein's A and B coefficients and expression for energy density, LASER Action and the Conditions for LASER action (Population Inversion and Pumping, metastable state), Requisites of a LASER system(Energy Source or Pumping Mechanism, Active medium and Resonant cavity (or) LASER cavity), three and four level Lasers.

Unit – II

Line shape broadening, Optical Resonance, Longitudinal and transverse modes in laser cavity,Oscillation gain and power output, Q- Switching, Mode locking, pulse shortening. Types and Applications of Lasers: Principles of Ruby, Nd: YAG, He-Ne, CO2, Semiconductor and dye Laser, Holography and its applications.

Unit – III

Optical Fiber, types of optical fibre, Propagation of light in optical Fiber, basic structure and optical path of an Optical Fiber, Acceptance Angle, Numerical Aperture, Modes of Propagation, Attenuation in Optical Fiber, Absorption losses, Bending Losses, Radiation Losses, Pulse Dispersion, Materials Dispersion.

Unit – IV

Optical Fiber sources: Light Emitting Diode (LED) as a source; Fiber- LED coupling; Bandwidth and Spectral Emission of LED. LASER. Optical fiber cable, fiber joints, splices, couplers and connectors, measurement in optical fibers, attenuation measurement, dispersion measurement, refractive index profile measurement.

Unit – V

Fabrication Methods for Fiber fabrication, Outside Vapour Phase Oxidation, Vapour Phase Axial Deposition, Double crucible method, Modified Chemical Vapour deposition, Signal Modulation & Demodulation in Optical Fiber Communication: Intensity Modulation of the Analog & Digital Signal, Frequency Modulation (FM), Pulse Width Modulation, Sensitivity of Fiber optic link.

BRANCH	Subject	Subject Code

M.Sc. (Physics)	Digital Electronics and Microprocessor	MPY2-542

Course learning outcomes (CLO):-

On successful completion of this course, the students will be able to:

1. Understand the historical contributions of Dr. B. S. Sonde in digital electronics.

2. Understanding Number systems and their inter- conversions.

3. Understand the characteristics of the ideal OP-Amp.

4. Understand the basics of 8085 microprocessor systems.

5. Understand the requirements to interface 8085 microprocessors to various peripherals.

Unit – I

Digital Electronics:

1. Indian pioneer of digital electronics :(Dr. B.S. Sonde), Overview of Indian research Institutes in digital electronics.
2. Number systems and their inter-conversions, binary addition and subtraction using 2's complement, Codes: BCD (8421), 2412, excess- 3, Gray, ASCII, alphanumeric codes, Parity generator and checker.
3. Logic gates:Logic gates and De-Morgan'n theorems, Boolean laws, simplification of logic circuits. Fundamental Products: SOP, POS and Karnaugh Maps. Adder,Subtractor, multiplexer and de- multiplexer.Flip flops: RS, D, JK, JK master slave flip-flops. Clocked level and edge triggered Flip-flop.

Unit – II

Block diagram of OP-Amp, characteristics of the ideal OP-Amp, OP-Amp Parameters: Input offset voltage, input offset current, Input bias current, CMRR, SVRR, large signal voltage gain, Slew rate, gain band width product, Output resistance,
Open loop and closed loop OP-Amp configurations, differential, inverting and non – inverting amplifiers, voltage series feedback amplifier, effect of feedback on closed loop gain, Input and output resistance, bandwidth, total output voltage.
Application of OP-Amp: Adder, Subtractor, Integrator and differentiator

Unit – III

Signal processing elements, DAC weighted resistor network, R-2R ladder network, ADC-Simultaneous, Counter type, Successive Approximation, single and dual slope; ADC and DAC specifications.

Unit – IV

Microprocessor:
Introduction to microprocessor systems, Architecture of 8085, Buses, Registers, Arithmetic logic unit, Trends in microprocessor developments.

Microprocessor programming:
Assembly and higher level languages, Addressing schemes, Instruction set for 8085, Assembly language programming using data transfer, Arithmetic and logic instructions, Stack and subroutine, Assemblers, Interpreters and Compilers, debugging.

Unit – V

Microprocessor Interfacing:
Interfacing, Dip switches, Seven segment display to 8085, General purpose programmable peripheral IC. 8255, Temperature controller, 8085 Interrupts, Simple examples using SIM and RIM instructions.

Data Communication:
Basic concepts transmission format, Error Checks, Data Communication over telephone line), Standards in serial I/O. Software controlled serial I/O. 8085 SID and SOD lines.

BRANCH	Subject	Subject Code
M.Sc. (Physics)	**Practical-I**	MPY2-543

Course learning outcomes (CLO):-

On completion of the course, the students will be able to

1. Determine wavelength of He-Ne laser.

2. Understand the concept of quantization of charge and measure the e/m by Millikan oil drop method.

3. Determine wavelength of LASER beam by diffraction grating using spectrometer.

4. Study the principles of amplitude and Frequency modulation.

5. Study the characteristics of loudspeaker system.

List of Practicals

1. To determine the wavelength of He-Ne laser light using single slit diffraction
2. To Determine e/m by Millikan oil drop method.
3. Using Michelson Interferometer, one can determine the wavelength of light from a monochromatic source.
4. To obtain velocity profile of flow in a pipe and verify Poiseuille Formula using He-Ne LASER.
5. To determine wavelength of LASER beam by diffraction grating using spectrometer.
6. Study of Amplitude Modulation & Demodulation.
7. Study of Frequency Modulation & Demodulation
8. Measurement of optical power using optical power meter.
9. To study the characteristics of loudspeaker system.
10. To determine the numerical aperture (NE) of optical fibres.

BRANCH	Subject	Subject Code
M.Sc. (Physics)	**Practical-II**	MPY2-544

Course learning outcomes (CLO):-

On completion of the course, the students will be able to

1. Understand the principle and circuit operation of a zero crossing detector.
2. Learn how an op-amp with positive feedback functions as a Schmitt Trigger.
3. Analyze Op-Amp as Integrator and Differentiator using 741 IC.
4. Write assembly language program using 8085 for 8 bit numbers.
5. Write assembly language program using 8085 for 16 bit numbers.

List of Practical

1. To study Op-Amp as Zero crossing Detector using 741 IC
2. To Study Op-Amp as Schmitt Trigger using 741 IC
3. To study Op-Amp as Comparator using 741 IC
4. Study of OP-AMP as voltage follower using 741 IC
5. Study of OP-AMP as Integrator and Differentiator using 741 IC
6. To draw a flow chart & write assembly language program for Addition and Subtraction of two 8-bit numbers using 8085
7. To draw a flow chart & write assembly language program to find sum of first 10 natural numbers using 8085 Microprocessor
8. To draw a flow chart & write assembly language program to add two 16 bit numbers with carry using 8085 Microprocessor
9. To draw a flow chart & write assembly language program to find the smaller number of two given numbers using 8085
10. To draw a flow chart & write assembly language program to find greater number from array using 8085 Microprocessor.