IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) - I Year (I Semester)
MPHYCC-101: Classical Mechanics

Objective: The objective of this course is to impart knowledge of fundamental concepts in the dynamics of system of particles, motion of rigid body, Lagrangian and Hamiltonian formulation.

UNIT-I **(8 Sessions)**
Introduction, Conservation Principles (Laws) and related skill development, Mechanics of a Particle, Skill development in learning the Mechanics of a system of Particles, Conservation of Linear momentum, Conservation of Angular Momentum, Newton's Laws and their Limitations.

UNIT- II **(10 Sessions)**
Calculus of Variations, Hamilton's Variation Principle, D'Alembert's Principle and Lagrange's Equations, Deduction of Lagrange's Equations from Hamilton's Principle, General Features of the Orbits, Motion Under Inverse Square Law- Kepler's Problem employability in astronomy, Rutherford Scattering.

UNIT-III **(10 Sessions)**
The Independent Coordinates of a Rigid Body and related skill development, Euler Angles, Angular Velocity and Momentum, Equations of Motion for a Rigid Body, Euler's Equations, Torque Free Motion of a Rigid Body-Poinsot's Solutions, Canonical Transformations: Canonical transformations, Poisson Bracket.

UNIT- IV **(8 Sessions)**
Concepts of small oscillations, Expression of kinetic energy and potential energy for the problems of small oscillations, Frequencies of Free Vibrations, Small oscillations and normal modes: Small oscillations about a stable equilibrium, Normal modes and their frequencies, Langrangian and Hamiltonian formalism of Classical Fields.

UNIT-V **(6 Sessions)**
Hamiltonian Formulation of Mechanics, Basic Concepts, Motion of the system and related skill development, Hamiltonians, Hamilton's Canonical Equations of Motion Deduction of Canonical Equations from Variation, Hamiltonian Jacoby theory, geometrical optics and wave mechanics.

Course Outcomes:
Students completing this course will be able to:
CO1: Understand the discipline-specific knowledge and skill development in classical mechanics, covering the subjects: Basic concepts of classical mechanics, Newton's laws and applications.
CO2: Derive Lagrange's equations and its employability in real problems, Hamiltonian formulations and oscillation's.
CO3: Able to describe and develop skills to understand planar and spatial motion of a rigid body, Rutherford scattering in laboratory and centre of mass frames, motion of a rigid body.
CO4: Understand the concept of small oscillations and to solve local problems of small oscillations.
CO5: Explain Hamiltonian formulation and its physical significance in global scenario.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	1	1	1	1	1	1	2	1	1	1
CO 2	1	2	1	1	1	1	2	1	1	1	1	1
CO 3	2	3	2	1	1	1	1	1	1	2	1	1
CO 4	1	3	1	1	1	1	2	1	1	1	1	1
CO 5	1	2	1	1	1	1	1	1	1	2	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	2	2	1
CO3	2	1	1
CO4	1	1	1
CO5	1	1	1

Suggested Readings:

1. Classical Mechanics – N. C. Rana
2. Classical Mechanics – H. Goldstein
3. Mechanics – A. Summerfield
4. Introduction to Dynamics - Perceival and D. Richards
5. Classical Mechanics – J.C. Upadhyaya

Website sources:

- https://ocw.mit.edu
- https://cnx.org
- https://sites.astro.caltech.edu
- https://www.damtp.cam.ac.uk
- http://www.physics.usu.edu

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) - I Year (I Semester)
MPHYCC-102: Mathematical Methods in Physics

Objective: The aim of this course is to familiarize students about curvilinear coordinates, matrices, integral and Fourier transform, special functions and their various properties that are being widely used in Physics.

UNIT- I **(10 Sessions)**

Polynomials- Legendre, Hermite and employability of the knowledge of Legendre polynomials and their generating functions. Recurrence relations and special properties of Pn(x) as solution of Legendre differential equation, Rodrigues formula, orthogonality of Pn(x), associated Legendre polynomials (Introduction only).

UNIT –II **(8 Sessions)**

Skill development through the learning the Bessel function of first kind, generating function, recurrence relations, Jn(x) as solution of Bessel differential equation, Expansion of Jn(x) when n is half and odd integer, Integral representation.

UNIT- III **(10 Sessions)**

Complex Variable: Function of a complex variable and its employability, Cauchy Riemann conditions, Cauchy's integral theorem (without proof), Cauchy's integral formula, Cauchy's Residue theorem, Jordan's Lemma; Evaluation of definite integrals, Principal Value, Bromwitch contour integrals.

UNIT- IV **(8 Sessions)**

Basics of Integral Transforms and its employability: Laplace Transform, First and second shifting theorems, Inverse LT by partial fractions, LT of derivative and integral of a function, Solution of Initial value problems by using LT, .

UNIT - V **(6 Sessions)**

Fourier series and Fourier Transform: Fourier series and its employability, half range expansion, arbitrary period, Skill development through the learning the Fourier integral and transforms and its employability, FT of delta and Gaussian function, Group Theory: Concept of a group (additive and multiplicative), Matrix representation of a group, Reducible and irreducible representation of a group,The Great Orthogona lity Theorem. Fourier transform, Sine, Cosine and Complex transforms with examples, Definition, Properties and Representations of Dirac Delta Function, Properties of Fourier Transforms.

Course Outcomes:

Students completing this course will be able to:

CO1: Develop skills to understand the Hermite and Legendre polynomials and their generating functions.

CO2: Explain Bessel function of first kind and to solve Bessel differential equation and its employability in real physical problems.

CO3: Develop skills of basic concept of complex variables and group theory.

CO4: Analyze the wide range of special functions and transformations of different series and its employability in real physical problems of global importance.

CO5: Describe various processes involved in understanding the behavior of different systems through Mathematics. Implement mathematical skills like Fourier series, Fourier transform etc. to solve local physical problems.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	1	2	2	3	1	1	1	1	1	1
CO 2	2	1	1	2	2	3	1	1	1	1	1	1
CO 3	2	3	1	1	1	1	2	1	1	1	1	1
CO 4	1	3	3	3	2	3	3	1	1	1	1	1
CO 5	1	3	2	3	2	1	3	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	1
CO2	2	2	1
CO3	1	1	1
CO4	2	2	1
CO5	1	1	1

Suggested Readings:

1. Mathematical method for Physics by G. Arfken
2. Advanced Engineering Mathematics by E.Kreyszig
3. Special Functions by E.D Rainville
4. Special Functions by W.W Bell

Website Sources:

- https://www.intechopen.com
- http://www.physics.gla.ac.uk
- http://www.crfm.it/
- https://learn.lboro.ac.uk

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) - I Year (I Semester)
MPHYCC-103: Quantum Mechanics

Objective: The objective of this course is to provide an understanding of the behaviour of the systems at microscopic (atomic and nuclear) scale and even smaller. Students would learn basic postulates and formulations of quantum Mechanics.

UNIT- I **(8 Sessions)**
Introduction & Review, Schrodinger wave equations and its employability, Eigen values &Eigen vectors, Probabilistic interpretation, Normalization of bound and continuum state wave functions,

UNIT- II **(8 Sessions)**
Hermitian operator and related skill development for employability, Commutator algebra and uncertainty relation, Orbital Angular Momentum, Angular Momentum Algebra, Spin, Addition of Angular Momenta, Three dimensional potential well and Hydrogen atom.

UNIT- III **(8 Sessions)**
Angular Momentum: Communication relation involving angular momentum operator, Skill development in learning the importance of Eigen value spectrum, Matrix representation of J, Addition of angular momentum, Clebsch- Gorden coefficients, Spin angular momentum, spin wave functions, Addition of spin and orbital angular momentum, Explicit Addition of Angular Momentum 1/2 with Angular Momenta 1/2 and 1, Spherical Harmonics in Central Field Problems, Spin-Orbit Coupling, Fine-Structure.

UNIT- IV **(8 Sessions)**
Skill development in learning the Matrix Formulation of QM and its importance- Diagonalisation of matrix, Dynamical and linear operator in matrix form, Dirac notations, Hilbert space, Liner harmonic oscillator in matrix formulation, Equations of Motion, Vector Representations of States, Projection Operators, Observables as Operators, Orthonomality and Completeness of States, Relation between Ket and Wave-functions, Wave-functions in Coordinate and Momentum Representations.

UNIT- V **(10 Sessions)**
Approximate method and related skill development for employability - Time independent first and second order perturbation theory for non-degenerate and degenerate levels, Variation method and its application for Helium atom, Stark effect, Dipole polarizability of ground state Hydrogen atom, Zeeman Effect.

Course Outcomes:
Students completing this course will be able to:

CO1: Develop skill to understand the importance of quantum mechanics compared to classical mechanics at microscopic level and Solve the Schrodinger equation to obtain wave functions for some basic physically important types of potential in one dimension solve Schroedinger equation for simple local potentials.

CO2: Develop skill to understand and interpret the wave function, and apply operators to it to obtain information about a particle's physical properties such as position, momentum and energy.

CO3: Gain knowledge about spin, angular momentum states, angular momentum addition rules and its employability scope in real physical problems.

CO4: Develop skill to relate the matrix formalism to the use of basis states, and solve simple problems in global scenario using that formalism.

CO5: Develop skill to understand the employability scopes in time dependent first and second order perturbation theory for non-degenerate and degenerate levels.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	2	3	1	1	3	1	1	2	1	1	1
CO 2	3	2	3	1	3	3	1	1	1	1	1	1
CO 3	3	1	2	2	1	2	1	1	1	1	1	1
CO 4	1	2	2	2	1	2	1	1	1	1	1	1
CO 5	2	1	3	1	1	3	1	1	2	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	3	1	1
CO3	3	2	1
CO4	2	1	1
CO5	3	2	1

Suggested Readings:

1. Quantum Mechanics by L.I. Schiff
2. Quantum Mechanics by Mathews & Venkatesan
3. Quantum Mechanics by Walton Greiner
4. Modern Quantum Mechanics by J.J. Sakurai
5. Introduction to Quantum Mechanics by E. Merzbacher.

Website Sources:

- https://ocw.mit.edu
- http://physics.weber.edu
- http://wcchew.ece.illinois.edu
- https://chem.libretexts.org
- https://ww2.odu.edu
- http://www.pas.rochester.edu
- https://en.wikipedia.org/wiki

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) - I Year (I Semester)
MPHYCC-104: Semiconductor Physics

Objective: The objective of this course is to give knowledge about semiconductor physics and explain the working and applications of basic devices, including transistors, amplifiers, BJT's and FET's, MOSFETs.

UNIT- I **(10 Sessions)**

Conduction Mechanism in Semiconductor

Skill development by learning the Classification of semiconductors and conduction mechanisms, Elemental and compound semiconductor, Direct band and indirect band gap semiconductor, Charge carriers in extrinsic semiconductors, Carrier concentration, Fermi level, Electron and hole concentration at equilibrium, Temperature dependence of carrier concentration, , Drift of carriers in electric and magnetic fields, Conductivity and mobility, Drift and resistance, Effect of temperature and doping on mobility, Hall effect Diffusion of carries in semiconductors, Diffusion processes, diffusion and drift of carriers, Diffusion and recombination, Continuity equation

UNIT- II **(8 Sessions)**

Bipolar Junction Transistor

Transistor current components, CB, CE, CC configuration, Input Output Characteristics, Early Effect, Graphical Analysis of the CE configuration, Ebers-Moll Model, Transistor as a switch, Skill development in to enhance the employability scopes through the learning of Bipolar Junction Transistor.

UNIT - III **(8 Sessions)**

Bias Stability and Hybrid Parameter

Stabilization against variation in Ico, V_{BE} and β, Stability factors S, S′ and S″, Transistor load line analysis, Method of transistor biasing: Base bias, Emitter bias, mixed type bias and Voltage divider bias.
Transistor Hybrid model, h parameters, Analysis of transistor amplifier circuit using h parameters, Measurement and graphical determination of h parameters, Hybrid π model, Skill development by learning the basics of Bias Stability and Hybrid Parameter in BJT.

UNIT - IV **(10 Sessions)**

Field Effect Transistors

Construction and characteristics of JFET, transfer Characteristics, FET small signal mode, measurement of gm and rd, JFET fixed bias, self-bias and voltage divider configuration , FET as voltage controlled resistor, JFET source- follower (common- drain) configuration , JFET Common –Gate configuration Depletion and enhancement type MOSFETs, Develop skills by learning Field Effect Transistors to enhance the scope of employability.

UNIT - V **(8 Sessions)**

Feedback amplifiers: Classification of Amplifier, feedback concept, Negative feedback amplifier, Analysis of feedback amplifier, Voltage Series feedback, Current series feedback, Voltage Shunt feedback, Current shunt feedback Nyquist Criterion for stability of feedback amplifier, Skill development by the learning the application of feedback amplifiers.
Metal/Semiconductor Contact, MOS Junction (Accumulation, Depletion, Inversion). Internal Structure (Block Diagram) Slew Rate, Frequency Response and Compensation, Applications (Linear and Non Line ar). TTl, MOS and CMOS Gates, Parrallel Binary adder/subtractor, BCD Addition/Subtraction, Encoder, Decoder, MUX, DE-MUX, Flip-Flops, Shift Resister, Counter, Memory Concept, RAM and ROM. Introduction to Microprocessor 8085

Course outcomes:

Students completing this course will be able to:

CO1: Develop skills to understand and explain the basic properties of semiconductors including the band gap, charge carrier concentration, doping and charge carrier injection/excitation and express the local conduction mechanism in semiconductor.

CO2: Develop skills to understand and analyze various transistor circuits in global perspective.
CO3: Illustrate various biasing circuits of a transistor.
CO4: Explain the working, design considerations and applications of various semiconducting devices including FETs. JFET and MOSFET.
CO5: Apply the concept of feedback in operational amplifiers and its employability.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	1	1	1	1	2	1	1	1	1
CO 2	3	3	2	1	1	2	1	1	1	1	1	1
CO 3	2	3	2	1	1	1	1	2	1	2	1	1
CO 4	3	2	3	1	1	1	1	1	1	2	1	1
CO 5	2	3	3	1	1	1	1	3	2	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	1	1	1
CO3	3	1	1
CO4	2	1	1
CO5	2	2	1

Suggested Readings:

1. Solid State Electronic Devices by B.G. Streetman.
2. Integrated Electronics by J.Millman and C.C. Halkias.
3. Electronics Devices and Circuit Theory by R.L. Boylested and L. Nashelysky.
4. Electronic Devices and Circuits by Balbir Kumar and S.B. Jain.
5. Physics of Semiconductor Devices by S. M. Sze.

Website Sources:

- https://shodhganga.inflibnet.ac.in
- http://www.eenadupratibha.net
- http://staff.utar.edu.my
- https://parthoduet.files.wordpress.com
- https://www.vssut.ac.in
- https://www.tutorialspoint.com
- https://www.electronics-tutorials.ws
- https://www.elprocus.com
- https://en.wikipedia.org

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) - I Year (I Semester)
MPHYCC-151: Physics Lab – 1

Objective: The main goal of this course is to share the knowledge to the students about the Experiments. The students will get a better understanding of the concepts studied by them in the theory course and correlate with experimental observations.

List of Experiments **(20 Sessions)**

1. To study the amplitude modulation and determine modulation index for the development of skills in Analog communications.
1. To study the frequency modulation and de modulation.
2. To study and plot the V-I characteristics of Photo Voltaic Cell (Solar cell).
3. To calculate the Hall coefficient and the carrier concentration of the sample material for the development of skills in determining the type of charge career in the materials.
4. To determine e/m the specific charge of an electron by magnetron method.
5. To study the frequency variation in Hartley oscillator and its employability in radio frequency applications.
6. To study and design the ripple counter.
7. To design T type and π type attenuators for 20 DB (decibel attenuation).
8. To study the characteristics of SCR and its application for the employability in electronics.
9. To study active filter using Op-amp.
10. To study the operation of a multivibrator.
11. To study IC 555 Timer.

Course outcomes:
Students completing this course will be able to:
CO1: Develop skills to attain practical knowledge of basic electronic circuits and components by performing experiments in laboratory.
CO2: Determine modulation index for national/ global level employability in Analog communications.
CO3: Plot V-I characteristics of photovoltaic cell.
CO4: Design T type and π type attenuators
CO5: Understand frequency variation in Hartley oscillator for the employability scope in electronics globally.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	2	1	3	1	2	1	1	2	1	1	1
CO 2	2	2	2	2	2	1	1	1	1	1	1	1
CO 3	2	3	1	2	1	2	1	1	1	1	1	1
CO 4	1	3	3	1	2	1	1	1	1	1	1	1
CO 5	1	3	3	2	1	1	1	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	1	2	1
CO3	2	1	1
CO4	2	1	1
CO5	2	2	1

Suggested Readings:

1. Solid State Electronic Devices by B.G. Streetman.
2. Integrated Electronics by J. Millman and C.C. Halkias.
3. Electronics Devices and Circuit Theory by R.L. Boylested and L. Nashelysky.
4. Electronic Devices and Circuits by Balbir Kumar and S. B. Jain.

Website Sources:

- https://www.niser.ac.in
- https://eceagmr.files.wordpress.com
- https://www.electronics-tutorials.ws
- https://www.tutorialspoint.com

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) - I Year (II Semester)
MPHYCC-201: Solid State Physics

Objective: This course introduces the basic concepts and principles required to understand the various properties exhibited by condensed matter, especially solids. The gained knowledge helps to solve problems in solid state physics using relevant mathematical tools.

UNIT -I **(8 Sessions)**

Develop skills to understand the basics of Band Theory of Solids, Density of states, K-space, Bloch wave, Bloch theorem, The Kronig-Penny model, origin of energy gap, Brillouin zones, Number of wave functions per energy band, Motion of electrons in one dimensional- according to band theory, Distinction between metals, insulators and intrinsic semiconductors.

UNIT-II **(10 Sessions)**

Theory of dielectrics and its employability in various engineering applications, Piezoelectricity and Ferroelectrics: Explanation of Polarization, Dielectric constant, Local electric field, Dielectric polarizability, Clausius-Mossoti Relation, Types of polarizability, Frequency dependence of dipolar polarizability, Calculation of Ionic & Electronic polarizability, Total polarizability, Measurement of dielectric constants. Piezoelectricity, Ferro electricity, Theories of ferroelectricity, Dielectric behavior above Tc, Spontaneous polarization below Tc, Ferroelectric Hysteresis, Applications of ferroelectrics, Onsager equation, Dielectric in an ac field, Dielectric loss, Havriliak-Nigami's equation for dielectric relaxation, Ferroelectric, Types and models of ferroelectric transition, Electrets and their applications, Piezoelectric and pyroelectric materials. Ferroelectric Hysteresis, Applications of ferroelectrics.

UNIT: III **(10 Sessions)**

Develop skills to understand the basic of Magnetism and its importance, Introduction, Classification of magnetic materials. Diamagnetism: Lagevin's classical theory of diamagnetism. Paramagnetism- Origin of permanent magnetic moments in paramagnetism, Lagevin's classical theory of paramagnetism. Weiss theory of paramagnetism, comparison of theory with experimental results. Paramagnetism at low temperature. Ferromagnetism, Antiferromagnetism and ferrimagnetism: Weiss theory of ferromagnetism, ferromagnetic domains, Bloch wall, Neel's model of ferrimagnetism, Magnetic aniostrophy, Magnetic domains, Magnetic order, Molecular theory, Hysterisis, Hard and soft magnetic materials, Ferrite structure, Magnons, Corrosion and its economical aspects, Aqueous corrosion process, Electrochemical kinetics of corrosion, Cathodic and anodic behavior, Tafel equations, Evans diagram, Thermodynamics of corrosion, Pourbaix diagrams, Prevention of corrosion, Material selection and design, Surface coating, Cathodic and anodic protection.

UNIT: IV **(8 Sessions)**

Photoconductivity & Luminescence; Develop skills to understand the basic of Photoconductivity and its applications: Photo conducting materials, Electronic transitions, Photoconductors, Absorption and Excitation, Trapping and capture, Recombination, Life time, Photosensitivity, Capture cross section, Simple model of photoconductor, Excitation, Absorption. Excitation across the gap, Trapping and its effects. Luminescence: Types of luminescence, Excitation and emission, Decay mechanism, Thallium activated alkali halides, sulphide phosphors.

UNIT: V **(6 Sessions)**

Superconductivity: Basic Concept, Occurrence, Meissner effect, Critical field, type-I, type-II superconductors, Critical currents, Thermodynamics of super conducting transitions, London equations, Coherence length, London penetration Depth, BCS theory of superconductivity, High Tc super conducting materials, Applications of Superconductivity and its employability in electronic industries.

Course Outcomes:

Students completing this course will be able to:

CO1: Develop skill to understand the Bloch theorem, The Kronig-Penny model and understand thee concept of reciprocal space lattice and know the significance of Brillouin zones.

CO2: Describe the dielectric properties and Polarizability and also its employability scopes globally.

CO3: Explain various types of magnetic phenomenon, physics behind them, their properties, applications and understand the origin of dia-, para-, and ferro-magnetic properties of solids.

CO4: Develop skills to understand Photoconductivity & Luminescence and also its employability scopes in global perspective.

CO5: Understand the basics of phase transitions and the preliminary concept of superconductivity in solid.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	1	1	1	1	1	1	1	2	2	1
CO 2	2	2	1	1	1	2	1	1	2	2	1	1
CO 3	2	3	1	2	2	1	2	1	1	1	2	1
CO 4	3	1	1	1	1	1	1	1	2	1	1	1
CO 5	3	1	2	1	1	1	1	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	1
CO2	2	2	1
CO3	1	1	1
CO4	1	2	1
CO5	1	1	1

Suggested Readings:

1. Introduction to Solid State Physics by C. Kittle.
2. Solid State Physics by A.J. Dekkar.
3. Introduction to solids by Azaroff.
4. Solid State Physics by S.L. Gupta & V. Kumar.
5. Solid State Physics by R. L. Katiyar.

Website Sources:

- https://lampx.tugraz.at
- http://www.egyankosh.ac.in
- https://www.phys.sinica.edu.tw
- http://bvcoend.ac.in
- http://www.irm.umn.edu
- https://en.wikipedia.org
- http://ecoursesonline.iasri.res.in

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) - I Year (II Semester)
MPHYCC-202: Atomic & Molecular Spectroscopy

Objective: The objective of this course is to impart knowledge of basics of atomic and molecular Physics that are needed for explanation of optical emission spectra of atoms and molecules.

UNIT-I **(10 Sessions)**

Develop the skill to understand the Bohr's theory and spectrum of Hydrogen atom: Types of spectra, Spectrum of H atom & Spectral series, Bohr's theory , Spectrum of H atom, Spin orbit coupling, Lamb shift, Isotopic shift ,fine structure of H and He+ lines, Hyper fine Structure & width of spectrum lines. Selection rules, Quantum numbers, space quantization, spectral terms and their notations.

UNIT-II **(10 Sessions)**

Quantum states of an electron in an atom, Spectrum of Hydrogen and Helium atom, fine structure Spectra of Alkali atoms; energy level diagrams, Sharp, Principal, Diffuse and fundamental series, Spectra of Alkali and Alkaline elements and its employability in various applications, Series in alkali spectra, Ritz combination principle, spin orbit interaction, Doublet structure in alkali spectra, Transition rules, Intensity rules, spectra of alkaline earth, elements, L-S & J-J coupling, selection rules, spectrum of He atom, spectral lines & their splitting.

UNIT – III **(8 Sessions)**

Covalent, Ionic and Vander wall's interactions, Develop the skill to understand the Born Oppenheimer approximation, Heitler-London theory of H2, LCAO treatment of H2+ and H2,Chemical binding, Selection rules, Nuclear spin and intensity alternation, Isotope effect, Classification of electronic states, Huckel method and its application to Ethylene, Butadiene and Benzene.,Changes in molecular geometry on electronic excitation.

UNIT – IV **(5 Sessions)**

Coupling of rotation and electronic motion, Develop the skill to understand coupling phenomena and its employability to describe the various properties of matter, Electronic bands, Franck- Condon principle, Correlation diagrams for molecules orbital's, Derivation of ground state of H_2 molecules.

UNIT- V **(10 Sessions)**

Develop skills to understand the Raman effect and its employability in materials science, Raman spectra, Classical & Quantum theory of Raman effect, Pure rotational Raman Spectra, Vibration rotation Raman spectra, X-ray spectra, X-ray photoelectron spectroscopy (XPS), Scanning electron microscopy (SEM), Auger electron spectroscopy (AES), Transmission electron microscopy (TEM), Atomic force microscopy (AFM), Thermo gravimetry analysis (TGA), Differential thermal analysis (DTA), differential scanning calorimetry (DSC), Raman spectroscopy, UV/Vis/Nir and FTIR spectroscopy.

Course Outcomes:

Students completing this course will be able to:

CO1: Develop skills to understand and interpret spectra, types of spectra, Hydrogen spectra, atomic emission / absorption spectroscopy.

CO2: Study alkali spectra and alkaline spectra, L-S and J-J couplings & their global scopes in employability.

CO3: Understand Born Oppenheimer approximation Heitler-London theory of H_2

CO4: Difference between atomic emission spectroscopy and atomic absorption spectroscopy and Atomic spectrum.

CO5: Develop skills to understand Raman Spectra and X ray Spectra, Differentiate between Vibrational and Rotational energy levels.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	1	1	1	2	1	1	1	1	1	1
CO 2	2	1	1	1	1	1	1	1	2	1	1	1
CO 3	3	1	1	3	2	1	1	1	1	2	2	1
CO 4	1	2	1	1	3	1	1	1	1	2	2	1
CO 5	1	1	1	1	2	1	2	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	1
CO2	2	2	1
CO3	2	1	1
CO4	1	1	1
CO5	2	1	1

Suggested Readings:

1. Introduction to atomic spectra- H.E White,
2. Spectra of diatomic molecules by Herzberg.
3. Atoms and molecules by M. Weissbluth.
4. Elements of Spectroscopy - Gupta Kumar & Sharma.
5. Introduction to Atomic and Molecular Spectroscopy by Vimal Kumar Jain

Website sources:

- https://courses.lumenlearning.com
- https://www.khanacademy.org
- https://en.wikipedia.org
- https://arshadnotes.files.wordpress.com
- https://sahussaintu.files.wordpress.com
- https://www.britannica.com

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) - I Year (II Semester)
MPHYCC-203: Communication Electronics

Objective: To provide in-depth knowledge of modern design tools to solve real-life problems in the field of Electronics and Communication.

UNIT-I **(8 Sessions)**

AMPLITUDE MODULATION & DEMODULATION

Communication systems, Develop skill to understand the basics of Modulation, Bandwidth requirements, Noise: External noise, Internal noise, Noise calculation, Noise figure, Amplitude modulation: Theory, Generation of AM, Basic requirement, Modulated transistor amplifiers, Single side band (SSB) techniques: Evolution of SSB, Suppression of carrier and unwanted side band, Demodulation: Envelop detection, Product detector. Receiver types- TRF receiver, Superhetrodyne receiver, AM receiver- RF section and characteristic, Frequency changing and tracking, intermediate frequency and IF amplifiers, AGC, Extension of superhetrodyne principle.

UNIT-II **(8 Sessions)**

ANGLE MODULATION & DEMODULATION

Theory of frequency and phase modulation- Mathematical representation of FM, Frequency spectrum of FM wave and its employability scopes in Analog communications, Phase modulation, Intersystem comparisons, Noise and frequency modulation- Effects of noise on carrier, Pre-emphasis de-emphasis, Comparison of wide band and narrow band FM, Stereo Phonic FM multiplex system, Generation of FM-FM methods, Direct methods, AFC. FM receivers- comparison with AM receiver, Amplitude limiting, Basic FM demodulators.

UNIT-III **(10 Sessions)**

TRANSMISSION LINES, RADIATION PROPAGATION AND ANTENNAS

Fundamentals of transmission lines, Characteristics impedence, Losses, Standing waves, Reactance properties of transmission lines, The Smith chart and its applications,

Ground (surface) waves, Sky wave propagation- The ionosphere, Space waves, Tropospheric scatter propagation, Extraterrestrial communications.

The elementary doublet, Wire radiator in space, Develop skill to understand the Antenna gain and effective radiated power, Antenna resistance, Bandwidth, Beamwidth and polarisation, Ungrounded antennas, Grounded antennas, Grounding systems, Effects of antenna height, Antenna coupling at medium frequency, Directional antennas- dipole arrays, Folded dipole and applications, The Yagi antenna.

UNIT-IV **(8 Sessions)**

SIGNAL ANALYSIS & SAMPLING

System and signals, Signal representation using Fourier series, Signal representation using Fourier transform, Develop skills in elementary understanding of Power spectral density.

Sampling theorem- Low Pass and Band Pass signals, PAM, Channel BW for a PAM signal, Natural sampling, Flat-top sampling, Signal recovery through Holding, Quantization of signals, Quantisation error.

UNIT-V **(8 Sessions)**

PULSE MODULATION SYSTEMS AND DIGITAL MODULATION TECHNIQUES

PCM, Differential PCM, Develop skills in elementary understanding of Delta modulation, Adaptive delta modulation, Noise in pulse code and delta modulation Systems: Calculation of quantization noise, Output signal power, Output signal-to-noise ratio in PCM. Binary phase shift keying (BPSK), Differential phase shift keying (DPSK), Quadrature phase shift keying (QPSK), Binary freuquency shft keying (BFSK).

Course Outcomes:

Students completing this course will be able to:

CO1: Study the fundamental concept of the amplitude modulation and demodulation and its global employabilty scopes in analog signals.

CO2: Acquire knowledge of angle modulation and demodulation.
CO3: Develop skills to understand fundamentals of transmission lines, radiation propogation and antennas to deal with local issues.
CO4: Gain knowledge of signal analysis and sampling.
CO5: Develop skills to study about pulse modulation system and various digital modulation techniques.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	2	1	1	1	1	1	2	1	1	1
CO 2	3	1	2	1	1	1	1	1	2	1	1	1
CO 3	2	2	1	1	1	1	1	1	1	1	1	1
CO 4	2	3	1	1	1	1	1	1	1	1	1	1
CO 5	1	2	1	1	1	1	1	1	1	2	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	2	1
CO2	2	1	1
CO3	2	1	1
CO4	1	1	1
CO5	2	1	1

Suggested Readings:

1. Electronic Communication System - G. Keneddy
2. Principles of communication systems, 2/e - Taub and Schilling,TMH
2. Digital and Commuincation system - Roden H.S., PHI
3. Analog and Digital Communication - Chakraborty, Dhanpat Rai
4. Advanced Electronics Communication Systems - Wayne Tomasi., PhI. Edn.
5. Digital and Analog Communication System- K. San Shanmugam, John Wile & Sons

Website sources:

https://en.wikipedia.org
https://www.tutorialspoint.com
https://resources.system-analysis.cadence.com
https://www.epa.gov
https://www.electronics-notes.com
https://vigyanprasar.gov.in

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) - I Year (II Semester)
MPHYCC-204: Statistical Mechanics and Thermodynamics

Objective: To learn the properties of macroscopic systems using the knowledge of the properties of individual particles.

UNIT - I **(8 Sessions)**

Macroscopic, Microscopic States & Statistical Ensembles and its employability to describe various properties of matter: Macroscopic States, Microscopic States, Phase Space, Density distribution in phase space, Liouville theorem, Micro canonical, Canonical & Grand Canonical Ensembles.

UNIT-II **(10 Sessions)**

Applications of Statistical Mechanics: Develop skills to understand the Maxwell- Boltzmann's Statistics, Quantum Statistics, Symmetric & Antisymmetric wave function, Gibbs paradox, Bose Einstein Statistics- Degeneracy and Einstein condensation, Femi-Dirac Statistics- Free Electron theory of Metals, Fermi energy, variation of Fermi energy with Temperature, Variation of specific heat with temperature.

UNIT-III **(10 Sessions)**

Basic Concepts and laws of thermodynamics and its scope in employability: Thermodynamic systems, thermodynamic variables, P-V diagrams, Zeroth Law of thermodynamics, first law of thermodynamics, second law of thermodynamics, third Law of thermodynamics (Kelvin Planck Statement IInd law of thermodynamics), Concept of Entropy, Enthalpy Reversible and in irreversible process, Joule's experiment, J-T cooling.

UNIT-IV **(8 Sessions)**

Develop skills to understand the importance of kinetic theory of gases: Pressure extend by a perfect gas, some deductions for the pressure, Expressions for most probable speed, average or mean speed and mean square speed of molecules, degrees of freedom, law of equipartition of energy, near free path, Transport phenomena (viscosity, thermal conduction, diffusion), Brownian motion.

UNIT -V **(6 Sessions)**

Thermo dynamical Relationships: Develop skills to understand the importance of thermodynamic potentials, Deduction of Maxwell's thermo dynamical relations by their corresponding potentials, their applications, Classification of phase transformations, Nucleation, Growth models, Landau theory, Types of phase changes, Diffusion in solids, Nucleation and growth, Solidification, Pearlitic transformations, Martensitic transitions, Phase rule, Interpretation of phase diagrams, Binary and ternary Phase diagrams, Microstructural development, Heat treatment and kinetics of phase transformations, Phase transitions, Invariant reactions, Eutectic, Eutectoid, Peritectic and pertectoid reactions, Free energy composition curves, Iron-iron carbide phase diagram..

Course Outcomes:

Students completing this course will be able to:

CO1: Develop skills to explain different ensemble theories to explain behavior of the systems.
CO2: Explain fundamentals and applications of statistical physics. The students will be able to elaborate the BE, FD and BE statistics.
CO3: Understand basic concept and laws of thermodynamics and their national/ global scope in employability.
CO4: Develop skills to explain kinetic theory of gases and transport phenomena.
CO5: Deduce Maxwell's thermo dynamical relations.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	2	2	2	2	2	1	1	1	2	1	1
CO 2	2	2	2	1	1	1	2	1	1	2	1	1
CO 3	1	1	1	1	3	1	1	1	1	1	2	1
CO 4	2	1	2	2	1	1	1	1	1	1	1	1
CO 5	3	2	1	1	3	1	1	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	1
CO2	2	1	1
CO3	2	2	1
CO4	2	1	1
CO5	2	1	1

Suggested Readings:

1. Elements of Statistical Mechanics by B.K. Agarwal.
2. Statistical Mechanics by K. Huang.
3. Elementary Statistical Mechanics by Kittle.
4. Heat & Thermodynamics by Brij Lal and N. Subramanyam.
5. Statistical Mechanics by R. K. Pathria.
6. Heat and thermodynamics by Mark W. Zemansky & Richard H. Dittman.

Website Sources

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- https://en.wikipedia.org
- https://www.theorie.physik.uni-goettingen.de
- https://en.wikipedia.org
- https://en.wikipedia.org
- https://madeeasy.in
- https://www3.nd.edu

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) - I Year (II Semester)

MPHYCC-251: Electronics Lab -1

Objective: The main goal of this subject is to share the knowledge to the students about the Experiments. The students will get a better understanding of the concepts studied by them in the theory course and correlate with experimental observations.

List of Experiments **(20 Sessions)**

1. To determine the value of electric charge by Millikan oil drop Method.
2. To observe the ON and OFF state of the transistor in an Astable Multivibrator and its employability scopes in electronics.
3. To observe the stable state voltages of Bistable Multivibrator and its employability scope in electronics.
4. To observe the stable state and quasi stable state voltages in Monostable Multivibrator and its employability scope in electronics.
5. Study of Absorption Spectrum of Iodine vapour lamp.
6. Study of adder, substractor, Integrator, Differentiator using Op-Amp.
7. To study the working of RS flip flop and JK flip flop and its employability scopes in electronics.
8. To study the working of shift registers.
9. To study the negative feedback amplifier.
10. To study the frequency variation in Colpitts oscillator.
11. To study constant Voltage Power supply
12. To study constant Current Power Supply

Course Outcomes:

Students completing this course will be able to:

CO1: Develop skills to design and evaluate various multivibrators.
CO2: Develop skills to design and evaluate various counters and registers and their national/ global scopes in employability.
CO3: Evaluate basic components of the digital circuits like flip-flops.
CO4: Evaluate and understand negative feedback amplifier.
CO5: Develop skills to understand frequency variation in Colpitts oscillator.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	3	1	2	2	1	1	1	1	1	1	1
CO 2	1	2	2	3	1	3	1	1	1	1	1	1
CO 3	3	2	2	2	1	2	1	1	1	1	2	1
CO 4	1	3	1	3	2	1	1	1	1	1	1	1
CO 5	1	2	1	2	1	2	1	1	1	2	2	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	2	2	1
CO3	1	1	1
CO4	2	1	1
CO 5	2	1	1

Suggested Readings:

1. Introduction to Solid State Physics by C. Kittle.
2. Introduction to solids by Azaroff.
3. Solid State Physics by S.L. Gupta & V. Kumar.
4. Solid State Physics by R. L. Katiyar.

Website Sources:

- https://www.niser.ac.in
- https://eceagmr.files.wordpress.com
- https://www.electronics-tutorials.ws
- https://www.tutorialspoint.com

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) -II Year (III Semester)
MPHYCC-301: Nuclear and Particle Physics

Objective: The objective of this course is to acquire knowledge in the content areas of nuclear and particle physics. Develop and communicate analytical skills in subatomic physics.

UNIT - I **(8 Sessions)**

Introductory Concept of Nuclei: Develop skills to understand basics of nuclear angular momentum, nuclear magnetic dipole moment and Electric quadruple moment, Parity quantum number, Statistics of nuclear particles, Isobaric spin concept, Systematic of stable nuclei, Nuclear Interaction Symmetry and Conservation laws , N-N interaction, quark model of the nucleon , The meson picture, the tensor part of the n-n force and the deuteron problem.

UNIT - II **(8 Sessions)**

Nuclear Disintegration: Develop skills to understand basics of Simple theories of decay, Properties of neutrino, Non-conservation of parity and Wu's experiment in beta decay, Electron capture, internal conversion, Nuclear Decays: a-decay ,b-decay and rudiments of neutrino physics, EM decay and selection rules.

UNIT -III **(10 Sessions)**

Inter Nucleon Forces: Develop skills to understand properties and simple theory of the deuteron ground state, Spin dependence and tensor component of nuclear forces, Nucleon- nucleon scattering at low energy, Charge- independence of nuclear forces, Many – nucleon systems and saturation of nuclear forces, Exchange forces, Elements of meson theory.

UNIT -IV **(10 Sessions)**

Nuclear Structure and Models: Employability scopes of Fermi gas model, Experimental evidence for shell structure in nuclei, Basic assumption for shell model, Single- particle energy levels in central potential, Spin-orbit potential and prediction of magic numbers, Extreme single- particle model, Prediction of angular momenta, Parities and magnetic moment of nuclear ground states, Liquid drop model, Semi-empirical mass formula, Nuclear fission, The unified model.

UNIT -V **(6 Sessions)**

Particle Physics: Properties and origin, Develop skills to understand basics of Elementary particles, Properties, classification, type of interactions and conservation laws, Properties of mesons, Resonance particles, Strange particles and Strangeness quantum number, Simple ideas of group theory, Symmetry and conservation laws, CP and CPT invariance, Quarks, Gell- Mann- Okubo mass formula, Dirac equation, helicity and chirality, quantization of Dirac fields.

Course Outcomes:

Students completing this course will be able to:

CO1: Acquire basic knowledge about nuclear properties such as mass, spin, radius, mass defect, binding energy etc.
CO2: Develop skills in the understanding of nuclear disintegration.
CO3: Develop skills to understand the characteristics of nuclear forces, exchange force and meson theory in global scenario.
CO4: Develop skills to understand the various nuclear models and its scope in employability.
CO5: Learn about the concept of elementary particle, quarks and conservation laws.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	1	1	1	1	1	1	2	1	1	1
CO 2	2	1	1	1	1	1	2	1	1	1	2	1
CO 3	3	2	1	1	2	1	2	1		1	2	1
CO 4	3	2	2	1	2	2	1	1	1	1	1	1
CO 5	2	1	2	1	1	2	1	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1
CO4	2	2	1
CO5	1	1	1

Suggested Readings:

1. Nuclear Physics by Roy & Nigam
2. Introduction to Nuclear Physics by H. Enge
3. Theoretical Nuclear Physics by J.M. Blatt and V.F. Weisskopf
4. Theoretical nuclear and Subnuclear Physics by J.D. Walecka
5. Particle Physics An introduction by M.Leon
6. Group Theory in Subnuclear Physics by F.I. Stancu
7. Nuclear Physics by D C Tayal

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- https://fys.kuleuven.be
- http://oregonstate.edu
- https://cds.cern.ch
- http://physics-database.group.shef.ac.uk
- https://www.physics.umd.edu

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) -II Year (III Semester)
MPHYCC-302: Advanced Quantum Mechanics

Objective: The objective of this course is to impart knowledge of advanced level in quantum mechanics and to teach about various approximation methods in physics to calculate the approximate values of energy for various systems.

UNIT -I **(10 Sessions)**
Identical Particles: Develop skills to understand the Symmetrization postulate, connection between spin and statistics, Pauli Exclusion Principle, wave function for Fermions and Bosons. Examples: Helium atom, Scattering of identical particles.

UNIT- II **(10 Sessions)**
Time dependent Perturbation Theory: Develop skills to understand the First order perturbation and its employability scopes, Interaction of an atom with electromagnetic field, transition probabilities, dipole approximation, Einstein A and B coefficients, Induced and spontaneous emission of radiations, Solution for a Free Particle, Negative Energy states and Hole Theory, Spin, Position Operator.

UNIT –III **(8 Sessions)**
Relativistic Quantum Mechanics
Develop skills to understand the Klein- Gordon equation and its plane wave solution, Probability density in Klein-Gordon theory, Dirac equation for free electron, Dirac matrices and spinors, Plane wave solutions, Charge and current densities Existence of spin and magnetic moment from Dirac equation of electron in an electromagnetic field, Covariance of Dirac Equation & Bilinear Covariants.

UNIT –IV **(6 Sessions)**
Develop skills to understand the Dirac equation for central field and spin orbit interaction, Energy levels of Hydrogen atom from the solution of Dirac equation, covariant form of Dirac equation.

UNIT -V **(8 Sessions)**
Develop skills to understand the Scattering Theory and its employability scope in quantum mechanics: Schrodinger equation for a free particle in three dimensions, expansion of plane waves in spherical harmonics, scattering by a potential, scattering amplitude and cross-sections, Born approximation, scattering by Yukawa and Coulomb potentials, concept of phase shifts, calculation of phase shifts from potentials, partial wave expansion of scattering amplitude, optical theorem and reciprocity theorems, scattering from a central potential, partial waves, resonances, formal theory of scattering.

Course Outcomes:
Students completing this course will be able to:
CO1: Develop skills to understand Identical Particles, Scattering of identical particles.
CO2: Explain time dependent Perturbation Theory, First order perturbation, dipole approximation.
CO3: Develop skills to understand Importance of relativistic quantum mechanics compared to non relativistic quantum mechanics for local problems.
CO4: Derive equation for central field.
CO5: Develop skills to understand scattering theory, concept of phase shifts.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1	2	1	2	1	1	1	1	1	1
CO 2	2	1	3	1	2	1	1	1	1	1	2	1
CO 3	1	2	1	1	1	2	1	1	1	1	2	1
CO 4	3	1	1	1	2	2	1	1	1	1	2	1
CO 5	1	3	1	1	1	1	1	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	1
CO2	1	1	1
CO3	2	1	1
CO4	1	1	1
CO5	2	1	1

Suggested Readings:

1. Quantum Mechanics by A.K. Ghatak and S. Lokanathan.
2. Quantum Mechanics by P.M.Mathew and K. Venkatesan.
3. Quantum Mechanics by. L.I. Schiff
4. Introduction to Quantum Mechanics by E. Merzbacher
5. Quantum Mechanics by S. Gasiorowicz
6. Modern Quantum Mechanics by J. J. Sakurai

Website sources

- https://www.southampton.ac.uk
- https://en.wikipedia.org
- http://www.tcm.phy.cam.ac.uk
- https://www.cmi.ac.in
- http://www2.chem.umd.edu
- https://ocw.mit.edu
- https://www.hep.phy.cam.ac.uk

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) -II Year (III Semester)
MPHYDE-303A: Electromagnetic Theory & Electrodynamics

Objective: The aim of this course is to build up the basic mathematical concepts related to electromagnetic vector fields and to give knowledge regarding the concepts of electrodynamics.

UNIT-I **(10 Sessions)**
Electro statistics
Develop skills to understand the Gauss' law and its application; Laplace and Poisson equations, boundary value problems.

UNIT-II **(10 Sessions)**
Magneto statics
Develop skills to understand the Biot-Savart law and its scope in employability, Ampere's theorem, Equation of Continuity, Electromagnetic Induction.

UNIT- III **(8 Sessions)**
Maxwell's Equation
Maxwell equation in free space and linear isotropic media, Displacement Vector, Scalar and vector potentials, Poynting theorem, Gauge Transformations: Coulomb and Lorenz Gauge, Transformation Properties of Electromagnetic Fields and Sources under Rotation, Spatial Inversion and Time Reversal.

UNIT- IV **(8 Sessions)**
Electromagnetic Waves
Develop skills to describe the Electromagnetic Waves in free space, in dielectric and in conductors, Reflection and Refraction, Polarization and dispersion (Fresnel's law, Interference, Coherence and diffraction) transmission lines and Guided waves or wave guides.

UNIT - V **(8 Sessions)**
Electrodynamics of a radiating System
Develop skills to understand the dynamics of charged particles in static and uniform electromagnetic fields, Retarded potentials, Radiations from moving charges, dipoles.

Course Outcomes:
Students completing this course will be able to:
CO1: Develop skills to understand electric and magnetic fields and apply the principles of Gauss's law to electric fields in various coordinate systems.
CO2: Explain the Biot-Savart law, Ampere's theorem, Equation of Continuity.
CO3: Develop skills to understand the depth of static and time-varying electromagnetic field as governed by Maxwell's equations.
CO4: Understand the electromagnetic waves, polarization and dispersion.
CO5: Develop skills to understand and study the electrodynamics of a radiating system for local problems.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	1	1	1	2	1	1	2	1	1	1
CO 2	2	2	1	1	1	2	1	1	2	1	1	1
CO 3	2	2	1	1	2	1	2	1	2	2	1	1
CO 4	3	3	2	1	1	2	1	1	1	2	1	1
CO 5	3	2	2	2	2	1	1	1	1	2	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	1
CO2	2	1	1
CO3	2	1	1
CO4	1	1	1
CO5	2	1	1

Suggested Readings:

1. Classical Electrodynamics by J.D. Jackson
2. Introduction to Electrodynamics - David j. Griffiths
3. Foundations of Electromagnetic theory by J.R. Reitz, F. J.Milford and R.W.Christy
4. Electrodynamics by S.L. Gupta, V. Kumar and S. P.Singh.
5. Electromagnetic Theory by U. A. Bakshi and A.V. Bakshi.

Website Sources

- http://site.iugaza.edu.ps
- https://eng.libretexts.org
- https://en.wikipedia.org
- https://www.photonics.ethz.ch
- https://ocw.mit.edu

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) -II Year (IV Semester)
MPHYDE-303B: Microwave Communication

Objective: To build up the concepts of basics of microwave communications to modern communications.

UNIT-I **(10 Sessions)**
Microwave Devices: Klystrons amplifiers, velocity modulation, Develop skill to understand the Basic principles of two cavity klystrons, Multicavity clystron amplifier and Reflex klystron oscillator, Magnetrons, principles of operation of magnetrons and travelling wave tube (TWT),Transferred electron devices, Gun effect, Principles of operations, modes of operation, Read diode, IMPATT diode, and TRAPATT diode.

UNIT- II **(6 Sessions)**
Develop skills to understand the basic of Amplitude modulation and its scope in employability, Frequency modulation, Maximum allowed modulation, Modulators and Balanced modulators, Square law demodulation, Frequency demodulation,

UNIT- III **(6 Sessions)**
Spectrum of an amplitude modulated signal, Develop skills to understand the phase and frequency deviation, Spectrum of an FM signal, Sinusoidal modulation, Bandwidth of a sinusoidally modulated FM signal, FM generation, Parameter variation method, Armstrong system.

UNIT-IV **(10 Sessions)**
Quantization of signals, Single side band modulation, Generating as SSB .VSB, CSS, modulation system Angle Modulation, Phase modulation, Develop skill to understand the relationship between phase and frequency modulation multiplexing and its scope in employability.

UNIT-V **(10 Sessions)**
Transmission and Radiation of signals: Primary line constants, phase velocity and line wavelength, Characteristic impedance, Propagation Coefficient, Develop skill to understand the phase and group velocities, Standing waves, Lossless line at radio frequencies, Voltage standing wave ratio, Slotted line measurements at radio frequencies, Transmission lines as circuit elements, Smith chart, Single and double Stub matching, Time domain reflectometry, Telephone lines and cables, Radio frequency lines.

Course Outcomes:
Students completing this course will be able to:
CO1: Develop skill to understand the concept of various Microwave devices.
CO2: Develop skill to understand Amplitude modulation, Frequency modulation, modulators and demodulation.
CO3: Develop skill to explain spectrum of an amplitude modulated signal and its global scope in employability.
CO4: Explain Quantization of signals.
CO5: Learn transmission and Radiation of signals.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	2	1	1	1	1	1	1	1	1	1
CO 2	2	2	2	1	1	1	1	1	1	1	1	1
CO 3	3	3	3	1	1	1	1	1	1	1	1	2
CO 4	3	3	3	1	2	2	2	1	2	2	1	2
CO 5	1	2	2	2	1	2	2	2	1	2	2	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	2	1	1
CO3	3	2	1
CO4	3	1	1
CO5	1	1	1

Suggested Readings:

1. Electronic Devices and circuit Theory by R. Boylested and L. Nashdsky
2. Principles of Communication Systems by H. Taub and Donald L. Schilling
3. Optoelectronics: Theory and Practice, Edited by Alien Chappal Microwaves by K.L. Gupta
4. Electronic communications by Dennis Roddy and John Coolen

Website Source:

- https://en.wikipedia.org
- https://www.electrical4u.com
- https://gradeup.co
- https://user.eng.umd.edu

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) -II Year (III Semester)
MPHYDE-304A: Electronics-1: Digital Electronics

Objective: To introduce students to the theoretical knowledge and develop practical skill in digital systems, logic systems microprocessor and electronic systems.

UNIT -I **(10 Sessions)**

Develop skill to explain the Operational Amplifier's Basic and Application: Review of Feedback, Linear Circuits, Op-Amp Basic, Inverting and Non inverting amplifiers, unity follower , summing amplifiers, integrator, differentiator, Op-Amp Specification-DC, Off –set parameter, frequency parameters, imperfection in Op-Amplifier application-multiple stage gain, voltage summing and subtraction , current controlled voltage source, voltage controlled current source, Rectifiers and limiters, Comparators and Schmitt Triggers, active filters, Difference Amplifiers; Broadband Amplifiers, Methods for achieving broad-banding ;Emitter Follower at High Frequencies; Operational Amplifiers and its Applications.

UNIT-II **(10 Sessions)**

Digital Logic Gates and its employability in electronics: Symbols and truth tables, Classes of digital integrated circuits (Diode logic, DTL,TTL,ECL, MOSFET,CMOS), Transistor- Transistor Logic (TTL), Single Input TTL Inverter (transfer characteristic), Multi – collector transistor ,Propagation delays, Diode logic, DTL NAND gate (transfer Characteristic, noise immunity, fan out), Emitter Coupled Logic (transfer characteristic of OR/NOR gate, practical implementation), MOSFET ,Logic Review of MOSFET, MOSFET Inverter with active load, MOSFET NOR and NAND gates, Complementary MOS (CMOS)- CMOS inverter, CMOS NOR and NAND, POWER dissipation in CMOS, Advantages/ Disadvantage of CMOS.

UNIT- III **(8 Sessions)**

Digital Electronics and Logic Gate: Binary, Octal, Develop skills to understand basics of Hexadecimal number system, Base conversion system, Bipolar and Field Effect transistor as switches, Basic digital logic gates(OR, AND ,NOT,NOR. NAND and Exclusive OR) XOR gate, Boolean laws and theorem, Sum of Product(SOP) and Product of Sum(POS) method, Karnaugh map, pair ,quad and octave, POS simplification, min term, max term.

UNIT-IV **(8 Sessions)**

Application of Digital Logic Gate: Develop skill to understand the Half adder and Full adder circuit and its employability scopes in electronics, multiplexers, de multiplexer, Flip flops and Registers- RS Flip Flop, T-Flip Flop, JK Flip Flop, JK Master Slave Flip Flop, Race problem, Preset and Clear functions, Astable, Mono stable and Bistable multivibrators, Type of registers, serial- in- serial out, serial –in- parallel out, parallel–in- serial out, parallel –in-parallel out. Counters and Convertors-Asynchronous and synchronous counter, Mod-3 and Mod-5 counter,shift counters, Digital to Analog Convertor-D/A converter ladder network, A/D converters.

UNIT-V **(8 Sessions)**

Microprocessor – Intel 8085 microprocessor architecture and its employability scopes in digital electronics, interfacing devices, BUS timing, instruction set, simple illustrative program.

Course Outcomes:

Students completing this course will be able to:

CO1: Develop skill to understand Operational Amplifier and their Applications.

CO2: Study Fundamental designing concepts of different types of Digital Logic Gates: Symbols and truth tables, Classes of digital integrated circuits.

CO3: Designing of different types of the Digital circuits, study the computational details for Digital Circuits and Convert different type of codes and number systems which are used in digital communication and computer systems.

CO4: Develop skill to analyze different types of digital electronic circuit using various mapping and logical tools and know the techniques to prepare the most simplified circuit using various mapping and mathematical methods.

CO5: Develop skill to understand Microprocessor program and their national/ global employability scopes.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	1	1	1	1	2	1	1	2	1	1
CO 2	2	2	2	1	1	2	1	1	1	1	3	1
CO 3	3	2	1	1	1	1	1	1	1	1	2	1
CO 4	3	2	2	1	1	1	1	1	1	1	1	3
CO 5	3	3	1	1	1	1	2	2	1	1	2	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	2	1	1
CO3	1	1	1
CO4	1	1	1
CO5	3	2	1

Suggested Readings:

1. Electronic Device and circuit by R. Boylested and L. Nashdsky
2. Analysis and Design of Digital Integrated Circuit by Hodges, Jackson and Saleh.
3. Digital Principals and Implementation by A.P Malvino and D.P leach.
4. Op-Amp and Liner Integrated Circuit by Ramakant A. Gayakwad.

Website Sources

- https://www.electronics-tutorials.ws
- https://en.wikipedia.org
- https://web.mit.edu
- https://india.oup.com
- http://mgcub.ac.in
- http://media.careerlauncher.com

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) -II Year (IV Semester)

MPHYDE-304B: Physics of Thin Films and Device Technology

Objective: To teach the fundamentals of the scientific principles behind thin-film technology and device technology.

UNIT- I **(10 Sessions)**

Growth and Characterization of thick and thin film, Develop skills in understanding the Vacuum Science and Technology: Vacuum pumps (Diffusion and Rotational), Vacuum gauges (Penning and Pirini), vacuum seals and Unit of vacuum and range, Thickness measurements of films Talystep, quartz crystal microbalance, optical methods.

UNIT-II **(10 Sessions)**

Electrical conduction in thin films, metals and insulators, determination of electrical parameters, Hall effect and its employability scopes, TEP measurements, DLTS, thin film diodes, transistors and capacitors.

UNIT –III **(8 Sessions)**

Optical properties of thin films, Develop skills for determination of optical constants, ellipsometry, SERS, nonlinear optics of 2D structures, devices-optical fibers, optical switches.
Photo thermal converters, photo electrochemical cells. Transducers and sensors, thermal sensors, pyrometes, radiations sensors, pH sensors, gas sensor and strain gauges, multiplexing action, Piezoelectric, pyroelectric and ferroelectric properties of thin films, Use of piezoelectric properties in devices.

UNIT - IV **(8 Sessions)**

Optoelectronic devices-solar Cells, Develop skills to understand basics of heterojunction lasers, photo detectors, electro chromic devices. Two dimensional structures and high speed quantum devices, semiconductor quantum wells, quantum Hall effect stepped super lattices, MOSFET, BET, HEMT, HET.

UNIT- V **(10 Sessions)**

Develop skills to understand various synthesis techniques employed in deposition of thin films and magnetic properties of thin films, magnetic recording and storage. Superconducting properties of thin films, high T. superconductors, Josephson Effect, SQUID and applications.

Course Outcomes:

Students completing this course will be able to:

CO1: Develop skills to understand various techniques to grow thin films.
CO2: Develop skills to study Electrical conduction in thin films, metals and insulators.
CO3: Study the mechanical, optical and electrical properties of thin films.
CO4: Develop skills to understand Optoelectronic devices, solar cells, electro chromic devices etc and its national/ global employability scopes.
CO5: Learn Magnetic properties of thin films, high T. superconductors and their local applications.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	1	3	1	1	1	1	1	1	1	1
CO 2	2	2	1	2	2	1	1	1	1	1	1	1
CO 3	3	2	1	3	2	2	1	3	1	2	2	1
CO 4	2	1	3	2	2	2	2	2	1	2	1	1
CO 5	3	1	3	2	2	1	1	2	2	3	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	1	1	1
CO3	2	1	1
CO4	2	2	1
CO5	2	1	1

Suggested Readings:

1. Handbook of thin film technology, L. I. Maissel and R. Glang. (McGraw-Hill).
2. Thin film phenomena, K. L. Chopra (McGraw-Hill).
3. Active and Passive thin film devices and applications,
4. T. J. Coutts (Academic Press).
5. Solid State Physics, H.Ibach and H, Luth (Norosa Publishers).
6. Thin films Solar Cells, K. L. Chopra, S. R. Das (Plenum Press).
7. Electronic Instrumentation and Measurement Techniques, W. D. Cooper (Prentice Hall).
8. Sensors and Transducers, M. J. Usher (Macmillan Publishers).
9. AIP Handbook for Modern Sensors, J. Fradon, (AIP).
10. Physics of Thin Films, Lckertova Plenum.

Website Source

- https://shodhganga.inflibnet.ac.in
- https://www.philliptech.com
- https://en.wikipedia.org

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) -II Year (III Semester)

MPHYCC-351: Physics Lab-2

Objective: To expose students to electronic devices and their evaluation techniques. The students will get a better understanding of the concepts studied by them in the theory course and correlate with experimental observations.

List of Experiments **(20 Sessions)**

1. Develop skills to study the series pass regulated power supply and to calculate its Parameters.
2. Develop skills to determine the value of Planck's constants h by Photo cell.
3. Develop skills to determine young's modulus and Poisson's ratio of glass by Cornu's method.
4. Develop skills to determine the energy band gap of semiconductor using four probe method and its employability in electronics.
5. To verify the Cos square law (Malus law) for Plane Polarized light with the help of Photo Voltaic cell.
6. To determine the Numerical Aperture of an optical Fibre.
7. To calculate the signal attenuation of optical Fibre.
8. Study of Analog to Digital convertor.
9. Study of Digital to Analog convertor.
10. To study attenuation constant (α), phase shift constant (β) and to study voltage distribution of transmission line.
11. To study of digital data communication
12. To Study of Rz and its detection

Course Outcomes:
Students completing this course will be able to:
CO1: Develop skills to evaluate value of Planck's constants.
CO2: Study energy band gap of semiconductor.
CO3: Evaluate Numerical Aperture of an optical Fibre.
CO4: Develop skills to study Analog to Digital convertor and its national/ global employability scopes in digital electronics.
CO5: Develop skills to Study Digital to Analog convertor and its national/ global employability scopes in digital electronics.
CO6: Study attenuation constant.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	1	1	1	1	1	1	1	1	1	1
CO 2	2	3	2	1	1	1	1	1	1	1	1	1
CO 3	1	1	2	1	1	2	1	1	1	2	1	2
CO 4	3	2	1	1	1	2	1	1	1	2	1	1
CO 5	3	2	1	1	1	1	1	1	1	1	1	1
CO 6	3	1	1	1	1	1	1	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	1
CO2	1	1	1
CO3	2	1	1
CO4	2	2	1
CO5	3	2	1
CO6	2	1	1

Suggested Readings:

1. Analysis and Design of Digital Integrated Circuit by Hodges, Jackson and Saleh.
2. Digital Principals and Implementation by A.P Malvino and D.P leach.
3. Op-Amp and Liner Integrated Circuit by Ramakant A. Gayakwad.

Website Source

- https://www.niser.ac.in
- https://maheshgandikota.files.wordpress.co
- https://instrumentationlab.berkeley.edu
- https://www.cisco.com

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) -II Year (IV Semester)
MPHYCC-401: Physics of Nanomaterial

Objective: To give exposure about various phenomena of Nano science and Nano technology and to teach them about influence of dimensionality of the object at Nano scale on their properties.

UNIT-I **(10 Sessions)**

Introduction to Nanostructure Materials: Develop skills to understand basics of Nanoscience & nanotechnology and their importance, Size dependence of properties, Moor's law, Surface energy and Melting point (quasi melting) of nanoparticles, Conducting polymers, Graphene.

Change band structure of nanomaterials: Change in energy gap, Density of Structure distribution, Effective masses and Fermi surfaces, Localized particles, Donors, Acceptors and Deep traps, Mobility, Excitons, Density of states, and Variation of density of states with energy and Size of crystal,

Basics of Nanotechnology, Application in medicine, Nano-therapy for combating cancer, What is green nanotechnology? Multi-dimensional impact of nanotechnology on health, nanotechnology in warfare, nano art, nano electronics, nano bots.

UNIT-II **(10 Sessions)**

Quantum Size Effect: Develop skills to understand basics of Quantum confinement and their employability in technological applications, Nanomaterials structures, two dimensional quantum system, Quantum well, Quantum wire and Quantum dot, Fabrication techniques,

UNIT-III **(8 Sessions)**

Characterization techniques of Nanomaterials: Structure and Size, Determination of particle size, Develop skill to understand basics of XRD (Scherrer's formula) and their employability in technological applications, Increase in width of XRD peaks of nanoparticles, Shift in absorption spectra peak of nanoparticles, Shift in photoluminescence peaks, Electron Microscopy: Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning Probe Microscopy (SPM), Scanning Tunneling Electron Microscopy (STEM), and Atomic Force Microscopy (AFM).

UNIT-IV **(8 Sessions)**

Optical Characterization: Absorption- Develop skill to understand basics of UV-VIS and their applications, -N.I.R, PL (Photo luminescence).

UNIT- V **(8 Sessions)**

Synthesis of Nanomaterials: Key issue in the synthesis of Nanomaterials, Different approaches of synthesis, Top down and Bottom up approaches, Cluster beam evaporation, Ball Milling, Chemical bath deposition with capping agent, Develop skill to understand basics of Carbon nanotubes (CNT)- Synthesis, Properties and Applications(LED, Solar cells, FET).

Course Outcomes:

Students completing this course will be able to:

CO1: Aware about Nano science and Nano technology in light of quantum confinement and band structure of nanomaterials.

CO2: Develop skill to understand various phenomenon's like quantum dot, quantum wire in light of Schrödinger equation.

CO3: Develop skill to explain various Characterization techniques of Nanomaterial.

CO4: Develop skill for Optical characterization UV- VIS- NIR and their national/ global scopes in employability.

CO5: Understand the Synthesis of various nanomaterials by various techniques with proper understanding.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	2	3	2	1	2	1	2	1	1	1	1
CO 2	1	1	3	2	1	2	1	1	1	1	1	1
CO 3	1	2	1	1	2	3	1	1	1	1	1	1
CO 4	1	1	1	2	1	2	1	2	1	1	1	1
CO 5	1	1	1	2	1	3	1	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	1
CO2	2	1	1
CO3	1	1	1
CO4	2	2	1
CO5	2	1	1

Suggested Readings:

1. Introduction to Nanotechnology, by Charles P. Poole, Jr. Frank J. Owens.
2. Quantum Wells, Wires and Dots by Paul Harrison.
3. Quantum Dot Hetrostructures, by D. Bimberg, M. Grundman, N.N. Ledenstov.
4. Introduction to Nanoscience and Nanotechnology by G.L.Hornyak , H.F.Tibbals, J. Dutta and J.J. Moore.
5. Carbon Nanotechnology by Liming Dai.
6. Nano material by A. K. Bandyopadyaya
7. Nano Science by Rakesh Kumar

Website sources

- http://www.nanophysics.pl
- https://www.nanowerk.com
- https://en.wikipedia.org
- https://shodhganga.inflibnet.ac.in

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) -II Year (IV Semester)
MPHYCC-402: Electronics – 2: Fiber Optics and Optical Fiber Communication

Objective: To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.

UNIT-I **(10 Sessions)**

Ray theory of transmission and preparation of optical fibers

Propagation of light in different media: Develop skills to understand propagation of light in an optical fiber, Basic structure and optical path of an optical fiber, Acceptance angle and acceptance cone, Numerical aperture (NA) (General), Modes of propagation, Meridional and skew rays, Number of modes and cut-off parameters of fibers Fiber Fabrication Techniques: Chemical vapour deposition technique, Double crucible method.

UNIT-II **(10 Sessions)**

Losses and Dispersion in Optical Fiber

Fiber Losses: Develop skills to understand Attenuation in optic fibers and their effects on efficiency, Materials or impurity losses, Rayleigh scattering losses, Absorption loss, Leaky modes, Bending losses, Radiation losses.

Dispersion in optical fiber: Electrical Vs. optical bandwidth. Bandwidth-length product, Intermodal dispersion, mixing modes, Material chromatic dispersion.

UNIT-III **(8 Sessions)**

Light Sources and Detectors for Optical Fiber

Light Sources: Introduction, Develop skills to understand basics of LED (Light Emitting Diode) and their employability in light sources, Processes involved, structure material and output characteristics of LED, Fiber LED coupling, Bandwidth, Spectral emission of LEDs, LASERS: Operation types, spatial emission pattern, Current Vs. output characteristics.

Detectors: Introduction, Characteristics of photo detectors (General),Photo emissive type, Photoconductive and photo voltaic devices, PN junction type, PIN photo diode, Avalanche photo diode (APD).

UNIT-IV **(8 Sessions)**

Fiber optic sensors, Communication systems and Modulation

Fiber optic sensors: Introduction, Develop skills to understand basics of Fiber optic sensors and their employability in optical fibre communication, Intensity modulated sensors, Micro bend strain intensity modulated sensor, Liquid level type hybrid sensor, internal effect intensity modulated sensor, Diffraction grating sensors and Interferometric sensors.

Communication systems :Transmitter for fiber optic communication, High performance transmitter circuit LED – Analog transmitter, LASER transmitter, Digital laser transmitter, Analog laser transmitter with A/D conversion and digital multiplexing, Fiber optic receiver,

Fiber based modems: Trans receiver. Modulation: LED analog modulation, Digital modulation, Laser modulation, Pulse code modulation (PCM), Intensity modulation (IM).

UNIT-V **(8 Sessions)**

Optical Fiber Communication and Measurements on Optical Fibers

Optical fiber communication systems: Introduction, Develop skills to understand important applications of integrated optic fiber communication technology, Long haul communication, Coherent optical fiber communication, Principle of coherent detection.

Measurements on Optical Fibers: Introduction, Measurements of numerical aperture (NA), Measurements of Fiber- attenuation, Optical time Domain Reflectometry (OTDR), Measurements of dispersion losses and Measurements of refractive index, Cut-off wavelength measurement, Measurements of Mode Field Diameter (MFD), near field scanning technique.

Basic optical communication system, wave propagation in optical fiber media, step and graded index fiber, material dispersion and mode propagation, losses in fiber, optical fiber source and detector, optical

joints and coupler. Digital optical fiber communication system, First/Second generation system, Data communication network.

Course Outcomes:

Students completing this course will be able to:

CO1: Develop skills to explain Ray theory of transmission and preparation of optical fibers.
CO2: Explain different types of Losses and Dispersion in Optical Fiber.
CO3: Develop skills to understand Light Sources and Detectors for Optical Fiber and its national/ global scope to employability.
CO4: Distinguish Step Index, Graded index fibers and compute mode volume.
CO5: Develop skills to understand optical Fiber Communication and Measurements on Optical Fibers.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	1	1	1	2	3	1	2	1	1	1
CO 2	3	2	2	1	1	1	2	1	1	1	1	1
CO 3	2	2	2	1	2	2	2	1	2	1	2	1
CO 4	2	3	1	1	1	2	3	1	1	1	1	1
CO 5	3	3	1	1	2	3	2	1	3	1	2	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	1	1	1
CO3	2	2	1
CO4	1	1	1
CO5	3	1	1

Suggested Readings:

1. Optical Fiber Communications: Principles and Practices by John M. Senior.
2. The Element of Fiber Optic by S.I.W. Meardon.
3. Optical Fiber Communication-by G. Keiser.
4. Introduction to Fiber Optics by A. Ghatak and Tyagrajan
5. Optical Fiber Communication by Joseph C. Palais
6. Fiber Optics by N.S. Kapany
7. Optical Fiber and Optical Fiber Communication Systems by S.K.Sarkar.

Website Sources

- https://technobyte.org
- https://shodhganga.inflibnet.ac.in
- http://aems.edu.sd
- https://en.wikipedia.org

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Master of Science in Physics Programme
M. Sc. (Physics) -II Year (IV Semester)

MPHYCC-403: Elements of Material Science

Objective: To learn fundamental concepts and the principles of materials science.

UNIT - I **(10 Sessions)**

Short review of basic structures, Develop skills to understand basics of Tetrahedral and octahedral sites and their properties and importance, substitutional and interstitial solid solutions (only definitions), coordination number and Pauling rules, Crystal Structures of metallic alloys, Ceramics, polymers, silicates, composite materials include structures such as NaCl, Rutile, flurite, Hexagonal and cubic zinc Blende, glass.

UNIT - II **(10 Sessions)**

Develop skills to understand basic concept of entropy and their employability in material science, derivation of expression for configurationally entropy using concept of multiplicity, micro and macrostates etc., free energies, chemical potential, derivation of various thermodynamical expressions, concepts of equilibrium and metastability, Phase diagrams of elements, applications of thermodynamics, Clapeyron equations for phase transitions, vapor pressures, effect of temperatures, its importance to vacuum systems and materials evaporation for thin films.

UNIT -III **(8 Sessions)**

Defects in Materials: Develop skills to understand basic concept of point defects, line defects (dislocations), surface defects (grain boundaries), volume defects (voids), defects formation energies, their impact on physical properties of materials, formation energies, defect creation and annihilation, thermodynamic aspects such as concentration and Interactions, stress fields.

UNIT- IV **(8 Sessions)**

Phase Diagrams: Develop skills to understand basic concept of solid solubility and their employability in formation of Alloys and compounds, Hume-Rothery rules, concept of formation of phase diagrams on basis of entropy and free energy changes for compositions, Phase diagrams of various categories.

Symmetry elements and Symmetry operations, Classification of molecules based on symmetry, Point group and space group Crystal structure- Primitive lattice cell, Fundamental type of lattices, Crystal systems, Close packing in crystals, Lattice planes, Miller indices of planes and directions, Bragg's Law, Reciprocal lattice, Ewald sphere, Atomic scattering factor, Structure factor, X-ray Diffraction- Powder, Laue and Rotation methods, Electron diffraction, Neutron diffraction and Synchrotron powder diffraction

Unit- V **(8 Sessions)**

Diffusion in solids: Develop skills to understand basic concept of concentration gradients, steady state non steady state flow, Fick's laws, error functions, diffusivity (macroscopic and microscopic diffusion models), importance of diffusion for materials synthesis and processing, examples and applications such as oxidation, corrosion, carborization, decarborization, nitridation, Nernst-Einstein equation, concentration profiles, etc.

Heat Treatment and Phase transformations in solids: Variation of free energies, nucleation and growth, surface and volume free-energies, Quenching, Nucleation rate, growth rates derivation of related expressions.

Course Outcomes:

Students completing this course will be able to:

CO1: Develop skills to study Atomic and Bonding Structures- Demonstrate understanding of different classes of materials and their atomic and bonding structures.

CO2: Learn the Concept of entropy, applications of thermodynamics

CO3: Develop skills to explain Defects in materials: point defects, dislocations, grain boundaries and voids in local perspective.

CO4: Develop skills to understand Phase Diagrams: Demonstrate an understanding of equilibrium phase diagrams and phase transformations.

CO5: Study diffusion in solids: Demonstrate an understanding of solid-state diffusion mechanisms Mechanical Properties: Demonstrate an understanding of mechanical properties of engineering materials and explain heat Treatment and Phase transformations in solids.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	1	1	1	1	1	1	1	1	1	2
CO 2	1	2	1	2	1	2	1	1	1	1	1	1
CO 3	2	3	1	1	1	1	1	1	1	1	1	1
CO 4	3	2	2	1	1	2	1	1	1	1	2	1
CO 5	1	3	1	1	1	1	2	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	1	1	1
CO3	2	1	1
CO4	2	1	1
CO5	2	1	1

Suggested Readings:

1. Physical Metallurgy, Vol. 1 and Vol. 2 by R. W. Chan and P. Hassen North Holland Publishing
1. Company, New York, 1983.
2. Materials Science and Engineering, V. Raghvan, (Prentice-Hall Pvt. Ltd.), 1989.
3. Introduction to Materials Science for Engineers,
4. J. F. Shackelford, (Macmillan Publishing Company, New York), 1985.
5. Physical Metallurgy, Smallman.
6. Thermodynamics, Swalin.
7. Physics of Semiconductor Device-Dekker, S. M. Sze.

Website sources:

- https://en.wikipedia.org
- https://www.tulane.edu
- http://www.physics.usu.edu
- https://sites.krieger.jhu.edu
- http://people.virginia.edu
- https://nptel.ac.in

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) -II Year (IV Semester)

MPHYOE-404: Nanotechnology

Objective: To provide an introduction to and an overview over nanotechnology, synthesis of nanoparticles and various analysis techniques.

UNIT- I **(8 Sessions)**

Basics of Nanotechnology, Application in medicine, Nano-therapy for combating cancer, What is green nanotechnology? Multi-dimensional impact of nanotechnology on health, nanotechnology in warfare, nano art, nano electronics, nano bots, Low dimensional materials. Application in Electronics, communication, medicine etc. Electron states in a potential well, spherically symmetric potential, Develop skills to understand basics of Coulomb potential and periodic potential. Tunneling through a potential barrier. Excitons, biexcitons, dark excitons.

UNIT- II **(8 Sessions)**

Clusters, Fullerenes, Semiconductor and metal clusters, cluster stability, Develop skills to understand basics of Nanotube and their employability in engineering applications, Graphene. Electron states in nanoparticles, effective mass approximation, weak confinement, strong confinement, size dependent oscillator strength, Discovery, Synthesis and Structural Characterization through TEM, Elementary Concept of its applications.

UNIT - III **(10 Sessions)**

Synthesis of nanomaterials (bottom up approach) by physical techniques. Introduction to vacuumtechniques (pumps, gauges, materials). Physical vapour deposition, electron beam evaporation, sputter deposition, laser ablation, ion beam mixing, Develop skills to understand basics of plasma deposition.

UNIT- IV **(10 Sessions)**

Develop skills to understand basics of Synthesis of nonmaterial by chemical, biological and hybrid routes, Concepts of colloids, LaMerdiagram, L.B. films, Miceller route, self assembly, biosynthesis, electrophoresis, immobilization in glass, zeolites, polymers.

UNIT - V **(8 Sessions)**

Analysis Techniques: UV-VIS-IR spectroscopy, Luminescence techniques, Develop skills to understand basics of X-ray and their applications, electron and neutron, Diffraction, Small Angle X-ray and Neutron Scattering, photon correlation spectroscopy, Extended X-ray, Absorption Fine Structure (EXAFS), X-ray Photoelectron Spectroscopy, Auger Electron Spectroscopy.

Course Outcomes:

Students completing this course will be able to:

CO1: Develop skills to determine low dimensional materials and applications.
CO2: Develop skills to understand synthesis of nanomaterials by physical techniques.
CO3: Develop skills to understand synthesis of nanomaterial by chemical, biological and hybrid routes knows which properties of materials must possess depending on application
CO4: Develop skills to understand Analysis Techniques- UV-VIS-IR spectroscopy and their national/ global employability scopes in determining the materials properties

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	3	1	2	1	1	1	1	1	1	1	1
CO 2	1	3	3	1	1	1	1	1	2	1	2	1
CO 3	1	1	2	1	1	1	2	1	1	1	2	2
CO 4	2	2	1	2	1	1	1	1	1	2	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	2	1	1
CO3	2	1	1
CO4	2	2	1

Suggested Readings:

1. Physics of Low Dimensional Structures, J. H. Davis, (Cambridge Press),
2. Semiconductor Quantum Dots, L. Bajaj and S. W. Koch.
3. Low Dimensional Semiconductors, M. J. Kelly, Clarendon,
4. Characterization of Materials, J. B. Wachtman and Z.
5. H. Kalman, Butterworth-Heinmann, USA,
6. Experimental Phyysics, Modern Methods, R. A. Dunlop.
7. Instrumental Methods of Analysis, H. H. Willard, L. L. Merritt, J. A. Dean and F. A. Settle, (CBS Pub.),

Website sources:

- https://worldwidescience.org
- https://en.wikipedia.org
- https://chem.libretexts.org

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Master of Science (Physics) Programme
M. Sc. (Physics) -II Year (IV Semester)
MPHYCC-451: Project Work & Viva Voce

The students should strictly adhere to the following points while preparing their final project report.

- Students are expected to undergo project work individually and submit individual project report for the development of their individual skills.
- Project reports should be typed / printed in double space using A4 size sheets.
- Table of contents should be in the specified format as provided by the supervisor.
- The students are asked to report to the concerned supervisors regularly during their project period to present their progress of work.
- No marks will be allotted on the Project Report unless a candidate appears at the Viva-Voce Examination. Similarly, no marks will be allotted on Viva-Voce Examination unless a candidate submits his/her Project Report.

Project Report and Viva-Voce Examination:

Project Report

It may be comprised of the following sections:

- Introduction
- Conceptual Framework/ National/International Scenario
- Presentation, Analysis & Findings
- Conclusion & Recommendations

Viva-Voce

In Viva-Voce Examination, the question may be asked in the following areas:

- Importance / Relevance of the Study
- Objective of the Study
- Methodology of the Study
- Analysis, findings, concluding observations, recommendation, limitations of the Study
- Overall Impression