St. Aloysius' College (Autonomous), Jabalpur
Department of Physics
Under CBCS System
2019 Onwards

M. Sc. IV Semester **Max Marks- 40**
Passing Marks - 14

PAPER - I
ATOMIC AND MOLECULAR PHYSICS

Course Outcome

The students are expected to acquire the knowledge of the following:

- Quantum states, spectra of one and many electron systems along with hyperfine structure.
- Normal and anomalous Zeeman effect
- Microwave Spectroscopy Rotational Spectra of diatomic molecules and its Intensity, Isotopic effect.
- IR spectra and its analysis, Vibrational and rotational motion of molecules, transition rules.
- Electronic spectra, Photo Electron Spectroscopy, Photo acoustic Spectroscopy, Raman Spectra, Mossbauer spectroscopy and NMR Spectroscopy.

UNIT –I

Quantum states of one electron atoms Atomic orbitals, Hydrogen spectrum, Paulis principle. Spectra of alkali elements, spin orbit interaction and line structure of alkali spectra, Methods of molecular quantum mechanics- Thomas-Fermi Statistical Model, Hartee and Hartee-Fock Method. Two electron system, interaction energy in LS and JJ coupling, Hyperfine structure (qualitative), line broadening mechanisms (general ideas), Normal and anomalous Zeeman effect, Lande's g-factor.

UNIT – II

Microwave Spectroscopy: Introduction to molecular spectroscopy, Regions of the Spectrum. Types of diatomic molecules; linear, symmetric top, asymmetric top and spherical top molecules. Rotational spectra of diatomic molecules; as a rigid rotator, Energy level and spectra of non-rigid rotator, intensity of rotational lines. Isotopic effect in Rotational Spectra. Technique and Instrumentation for Microwave Spectroscopy.

UNIT – III

Infra-red Spectroscopy: Vibrational energy of diatomic molecule, diatomic molecule as a simple harmonic oscillator, Energy levels and spectrum, Morse potential energy curve, Molecules as vibrating rotator, vibration spectrum of diatomic molecule, PQR branches. Technique and Instrumentation for Infra-red Spectroscopy. Analysis of IR Spectrum with example.

UNIT – IV

Raman spectroscopy: Introduction, Pure rotational and vibrational spectra, Techniques and instrumentation, Stimulated Raman spectroscopy.

Electronic Spectra of Diatomic Molecules: The Born Oppenheimer Approximation, Vibrational Coarse Structure Progressions, Rotational fine structure of Electronic-Vibrational Transitions.

Experimental techniques: Photo Electron Spectroscopy, Elementary idea about Photoacoustic Spectroscopy, Mossbauer spectroscopy and NMR Spectroscopy.

UNIT –V

This unit will have tutorial problems covering all the four units. Some sample problems are:

1. Write all possible term symbols for the following electron configurations

   (a)[Be]2p3p (b) [He]2s2p

2. Compute the Zeeman pattern, Arising terms, No. of Zeeman level, g-factor and Shift in Lorentz unit for following:

   (a) $^2D_{3/2}$-$^2P_{1/2}$ (b) $^3P - {}^3S$

3. The measured value of the first line (J = 0) in the rotational spectrum of carbon monoxide is 3.84235 cm^{-1}. Determine the moment of inertia and bond length of the molecule.

4. The data for the $^1H^{35}Cl$ molecule are :

   Bond length = 127.5 pm

   Bond force constant = 516.3 Nm^{-1}

   Atomic masses : $^1H = 1.673 \times 10^{-27}$kg, $^{35}Cl = 58.066 \times 10^{-27}$ kg

   Determine the following:

   (a) The energy of fundamental vibration ν_o.

   (b) The rotational constant B.

   (c) The wave numbers of the line $P_{(1)}$, $P_{(2)}$, $R_{(0)}$, $R_{(1)}$ and $R_{(2)}$.

   (d) Sketch the expected vibration-rotation

5. How many normal models of vibration are possible for the H_2O molecule?

6. The bond between the hydrogen and chlorine atoms in a $^1_1H^{17}{}_{35}Cl$ molecule has a force constant of 516 nt/m. Calculate the energy difference between the lowest and first excited vibrational level.

7. The molecules of $^1_1H^{17}{}_{35}Cl$ show a strong absorption line of wavelength 3.456 microns. Assuming origin of line due to vibration, calculate the force constant for $^1_1H^{17}{}_{35}Cl$ bond. ($h=6.6\times10^{-34}$Jsec, 1amu=1.67×10^{-27}kg)

8. With which type of spectroscopy would one observe the pure rotational spectrum of H_2? If the bond length of H_2 is 0.07417 nm. What would be the spacing of the lines in the spectrum ?

9. A substance shows a Raman line at 4567Å when exciting line 4358 Å is used. Deduce the position of Stoke and anti-stoke lines for the same substance when the exciting line 4047 Å is used.

10. In the Raman spectra of HCl, the displacement from the exciting line are represented by

$$\Delta\upsilon = \pm (62.4 + 41.6\ J)\ cm^{-1}$$

   Calculate the moment of inertia of the HCl molecule ($h = 6.62\times10^{-27}$ erg-sec, $c = 3\times10^{10}$cm-sec^{-1})

In addition to above the tutorial will also consist of solving problems given in the Text and References books.

Text and Reference Books:

- Introduction to Atomic Spectra : H.E. White
- Fundamentals of molecular spectroscopy : C.B. Banwell
- Atomic & Molecular Spectroscopy : Rajkumar
- Spectroscopy vol. I, II & III : Walker and Stanghen

- Introduction to molecular spectroscopy : G.M. Barrow
- Spectra of diatomic molecules : Herzberg.
- Molecular spectroscopy : Jeanne L. Mc Hale
- Molecular spectroscopy : J.M.Brown
- Spectra of atoms and molecules : P.F.Bemath.
- Modern spectroscopy : J.M. Halian
- Spectroscopy : Gour
- Atomic & Molecular Physics : Rajkumar

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2019 Onwards
M. Sc. IV Semester **Max Marks- 40**
Passing Marks - 14

Paper - II
ELECTIVE PAPER
(ANY ONE TO BE OPTED)

ELECTIVE PAPER (a): CONCISE STUDY OF NON-LINEAR SYSTEMS

Course Outcome

The students are expected to acquire the knowledge of the following:

- Critical points, their classification and stability. Generate and visualize trajectories in phase space. Poincare sections.
- Iterated functions, period doubling, bifurcation, stability, chaos and Feigenbaum number. Strange attractors.
- Fractals as self-similar structures, determination of fractal dimension. Fractal dimensions, boundaries and the Richardson plot.
- Overview of different nonlinear systems.
- Cellular Automata, Julia and Mandelbrot plots

Unit I

Phase space, orbits, attractors and basin of attraction. Use of the Jacobian matrix in Analysis of Singular points. Classification of Singular points(Vortex, spiral, node,saddle) and their stability. Poincare's theorem for the vortex. Use of Lyapunov's theorem for stability. Limit cycles. Poincare sections. Distinction between Non conservative and Conservative Maps taking as example the Henon map.

Unit II

Iterated functions. The Logistic Map. Its geometrical representation and period doubling cascade to chaos. Bifurcation, stability and Feigenbaum number. Characterizing chaos by the Lyapunov exponent. Strange attractors in the form of the Lorenz system and Rossler system. The Poincare section of strange attractors in the chaotic domain.

Unit III

Non-fractal dimensions (Euclidean and topological). Fractal Dimensions and similarity dimension. Cantor Sets, Koch curve and Sierpinski gasket. Fractal boundaries and box counting dimension. The structured walk technique and the divider dimension. The Richardson plot. The perimeter-area relationship in fractals.

Unit IV

Overview of different nonlinear systems. (Study based on phase plot or graphical representation of the equations of nonlinear systems)

a. Nonlinear Mechanics: The non-linear Simple Pendulum
b. Biological Systems: Volterra-Lotka Competition Equations
c. Electronic Systems: Van der Pol Oscillator
d. Chemical Systems: Chemical Oscillators(The Brusselator / Oregonator)

e. Fluid Motion: Rayleigh–Benard Convection
f. Solitons: Shallow water waves (KdV equation)

Unit V

This unit will have tutorial problems covering all the four units. Some sample problems are:

Overview of different nonlinear systems. (Study based on phase plot or graphical representation of the equations of nonlinear systems.)

a. The Poincare section and Chaotic oscillation of the Duffing Oscillator
b. Self similarity (Fractal structure) in the Henon map
c. Self similarity (Fractal nature) of Julia sets
d. Self similarity (Fractal nature) of Mandelbrot sets
e. Cellular Automata as examples of simple rules leading to complex patterns.
f. Self similarity (Fractal nature) of Cellular Automata
g. SIR model for epidemics.

In addition to above the tutorial will also consist of solving problems given in the Text and References books.

Suggested Books:

a. The New Kind of Science Book by Stephen Wolfram
b. Non linear Dynamics by H G Solari, M A Natiello and G B Mindlin
c. Introduction to Chaos by H Nagashima and Y Baba
d. Deterministic Chaos by N Kumar
e. Fractals and Chaos by Paul S Addison
f. Non linear Physics for Students and Engineers by Enns and Mc Guire
g. Non Linear Dynamics and Turbulence by Barenblatt, Looss and Joseph

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PAPER II
ELECTIVE PAPER (b): PHYSICS OF LASERS AND ITS APPLICATIONS

Course outcome

The students are expected to acquire the knowledge of the following:

- Basics of lasers and their working principle.
- Structure and basic operating principles of different laser systems and their applications.
- Laser based various spectroscopic techniques.
- Basics of non-linear optics.

UNIT –I

Working principle of laser, threshold condition, characteristics of laser. Gaussian beam and its properties, optical Resonators, longitudinal and transverse modes of laser cavity, mode selection, gain in a Regenerative Laser cavity.

Rate equations and threshold for 3 and 4 level systems. Q-switching, mode locking and obtaining ultra-short pulses. Spectral narrowing.

UNIT – II

Ruby laser, He-Ne laser, Nd based lasers, Semiconductor lasers, Nitrogen laser, CO_2 laser, Ion-laser, Dye laser, Chemical laser, Excimer laser, High power laser systems.

UNIT –III

Laser fluorescence and Raman scattering and their use in ranging and pollution studies; ultra high resolution spectroscopy with laser, and its application in isotope separation, single atom detection and rotational and vibrational level of molecules. Optical fibers, use of lasers in light wave communication. Qualitative treatment of medical and engineering applications of lasers.

UNIT – IV

Crystal optics, propagation of light in a medium with variable refractive index, Electro-optical effect. Non-linear interaction of light with matter, laser induced multiphoton processes, second harmonic generation, phase matching, third harmonic generation, optical mixing. Parametric generation of light, self focusing of light. Frequency mixing in gases and vapours, Optical bistability and optical phase conjugation, Frequency up-conversion.

UNIT – V

This unit will have tutorial problems covering all the four units. Some sample problems are:

1. Calculation of threshold population inversion for laser action in a cavity of given parameters.
2. Calculation of gain coefficient.

3. Determination of line width of laser line.
4. Determination of line pulse duration in case of Q switched or mode locked laser.
5. Calculation of power of the laser output in case of certain laser system.
6. Tuning of laser in order to obtain- a particular wave length.
7. Finding distance of an object by laser range finder.
8. Determination of vibrational levels of molecule by scattering of laser light.
9. Calculation of intensity of second harmonic and third harmonic generated by non-linear interaction of laser light with matter.
10. Calculate the wave length separation between the longitudinal modes of a 1530 nm semiconductor laser in which the active layer in 0-2 μm long and has a refractive index of 4.0.

In addition to above the tutorial will also consist of solving problems given in the Text and References books.

Text and Reference Book

- Svelte : Lasers
- Yariv : Optical Electronics.
- Demtroder : Laser spectroscopy
- Letekhov : Non-Linear Laser spectroscopy
- Lasers : A.L. Siegman
- Optical Electronics : K.Tyagrajan & A.K. Ghatak.

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PAPER II

ELECTIVE PAPER (c) PHYSICS OF NANOMATERIALS

Course Outcome

The students are expected to acquire the knowledge of the following:

- Quantum confinement effect.
- Quantum well and super lattices.
- Synthesis, characterization techniques of nanomaterials.
- Optical and electrical properties of nanomaterials.

UNIT-I

Concept of Quantum Confinement

Free electron theory (qualitative ideas) and its features. Idea of band structure, Metals, insulators and semiconductors, Density of states in bands, Variation of density of states with energy.

Electron confinement in infinitely deep square well, confinement in two and three dimension, Idea of quantum well, quantum wire and quantum dots, classification of nanostructured materials.

UNIT-II

Quantum wells and Super-lattices

Energy levels and density of states in quantum wells. Band structure in quantum well, coupling between the wells, multiple quantum well structure (MQW), super-lattice (SL) dispersion relation and density of states, Band structure in super-lattice, Types of super-lattices.

Techniques of Fabrication of MQW and SL structures (MBE, MOCVD, LPE etc).

UNIT-III

Nanoparticles

Synthesis of nanoparticles: Bottom up: cluster beam evaporation, ion beam deposition, chemical bath deposition with capping techniques; and Top down: Ball milling.

Physical properties of nanoparticles: Impurities and composition surface roughness, structure, thermodynamic properties. Determination of particle size by width of XRD peaks.

UNIT-IV

Characteristics of nanoparticles

Optical properties : Absorption spectra, luminescence, Raman scattering, spectral response. Determination of particle size by shift in photoluminescence peaks.

Electrical properties of nanoparticles, nanostructured magnetic materials, stability of nanocrystals. Application of nanostructured materials.

UNIT-V

This unit will have tutorial problems covering all the four units. Some sample problems are:

(1) Density of state function in 1D, 2D and 3D systems.

(2) Calculation of energy levels and change in band gap in a quantum well of given dimensions.

(3) Energy difference between two levels in a double QW.

(4) Variation of specific heat with size of crystal.

(5) Calculation of crystal size from XRD peaks.

(6) Calculation of crystal size from PL peaks.

In addition to above the tutorial will also consist of solving problems given in the Text and References books.

Text and References Books

- Nanotechnology Molecularly designed material by Gan-Moog, Chow , Kenneth. E Gonsalves, American Chemical Society.
- Quantum dot hetero-structure by D. Bimerg, M. Grundmann and N.N. Ledentsov John Wiley and Sons 1998.
- Nanotechnology: Molecular Speculations on global abundance by B.C. Grandall MIT Press 1996.
- Physics of low dimensional semiconductors by John W. Davies, Cambridge Univ. Press 1999.
- Physics of semiconductor nanostructures by K.R. Jain Narosa 1999
- Nano-fabrication and bio-systems: Integrating materials science engineering Science and biology by Harvey C. Hoch, Harold G. Craighead and Lynn Jelinski, Cambridge Univ. Press- 1996.
- Nano particles and nano structured films: Preparation, characterization and application, Ed. J. H. Fendler, Jhon Wiley and sons 1998.
- Wave mechanics applied to semiconductor heterostructures by Gerald Bastard.

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PAPERS III

SPECIAL PAPER (a) CONDENSED MATTER PHYSICS – II

Course Outcome

The students are expected to acquire the knowledge of the following:

- Superconductors and theories, Acoustic, optical phonons and polarons. Josephson Effect, High T_c superconductors.
- Point defects, Structure and symmetries of liquid crystals and amorphous solids.
- Fullerenes, Three dimensional carbon nanotube structures, Synthesis and characterization of nanostructures materials.
- Disorder in condensed matter, Anderson model for random systems

UNIT – I

Interaction of electrons with acoustic and optical phonons, polarons, Superconductivity : Manifestations of energy gap, Cooper pairing due to phonons, BCS theory of superconductivity, Ginzsburg –Landau theory and application to Josephson effect : d-c-Josephson effect, a-c Josephson effect, macroscopic quantum interference. Vortices and type II superconductors, high temperature superconductivity (elementary).

UNIT – II

Point defects : Shallow impurity states in semiconductors. Localized lattice vibrational states in solids, vacancies, interstitial and colour centers in ionic crystals.

Structure and symmetries of liquids, liquid crystals and amorphous solids. Aperiodic solids and quasicrystals; Fibonaccy sequence, penrose lattice and their extension to 3-dimensions.

UNIT – III

Special carbon solids; fullerenes and tubules, formation and characterization of fullerenes and tubules. Single wall and multi -wall carbon tubules. Electronic properties of tubules. Carbon nanotubule based electronic devices. Definition and properties of nanostructured materials. Methods of synthesis of nanostructured materials. Experimental techniques for characterization of nanostructured materials. Quantum size effect and its applications.

UNIT - IV

Disorder in condensed matter, subsitutional, positional and topographical disorder, short and long range order. Atomic correlation function and structural description of glasses and liquids.

Anderson model for random systems and electron localization, mobility edge, hopping conduction. Qualitative application to amorphous semiconductors.

UNIT - V

This unit will have tutorial problems covering all the four units. Some sample problems are:

1. Draw diagrams showing some possible two-phonon processes in which a neutron enters with momentum p and leaves with momentum P'. In labeling the diagrams take due account of the conservation law.
2. The average rate of dissipation of energy for an electromagnetic wave is W = < E.J.> where the average is over a complete cycle. Show that

$$W = (\omega\varepsilon_2/ 8\pi)E_o^2 = \sigma E_o^2/2 = \sigma_1 E^2$$

3. How do the (2l+1) fold degenerate energy levels of a free atom split up in a crystal field invariant to all proper rotations which transform a cube into itself ? The free atom is invariant to operations of the (infinite) rotation group. The characters of the irreducible representations of this group are

$$\lambda^{(l)}(\varphi) = \sin (l + ½) \phi/ \sin \phi/2$$

The point group of the crystal field has 24 elements in five classes and hence also five irreducible representations. Set up character table for this group

4. (a) Show whether periodicity can exist together with a periodicity in a structure (b) What is golden mean ratio ? How it is relevant to quasi crystals.
5. Band structure formula for crystals is not quite valid for Nanostructure, why?
6. Distinguish between crystalline, amorphous solids and liquids.
7. What are onion carbon structure ? How are they related with fullerene.
8. Calculate the lifetime of electrons and holes in a semiconductor with recombination centers (acceptors with levels E_R in the energy gap) Treat explicitly the limits of large and small defect concentration n_r. Discuss the recombination mechanism in both cases. Compare the two possible definitions : $\delta n(t) – \exp (-t/ \tau)$ (decay time) and $\delta n = G\tau$ (steady state).
9. The carbon nanotubules can be both semiconducting and metallic why?

In addition to above the tutorial will also consist of solving problems given in the Text and References books.

Text and References Books

Crystal Structure Analysis	:	Burger
The Physics of Quasicrystals,	:	Eds steinhardt and Ostulond
Hand Book of Nanostructured Materials and Nanotechnology (Vol. l to 4)	:	Ed. Hari Singh Nalwa
Quantum Theory of Solid State	:	Callaway
Theoretical Solid State Physics	:	Huang
Quantum Theory of Solids	:	Kittle
Introduction to Solid State Theory	:	Madelung
Solid State Physics	:	J.P. Shrivastava
X-ray Crystallography	:	Azaroff
Elementary Dislocation theory	:	Weertman and Weertman
Crystallography for Solid State Physics	:	Verma and Shrivastava
Solid State Physics	:	Kittel
Elementary Solid State physics	:	M. Ali Omar

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PAPER IV

SPECIAL PAPER (b) : A Course In COMPUTATIONAL PHYSICS USING MATHEMATICA– II

Course Outcome

The students are expected to acquire the knowledge of the following:

- Plotting of the intensity-distance and simulation of the diffraction patterns for a straight edge, a single slit, Newton's ring.
- Computationally analyzing the linear harmonic oscillator, particle bound in an infinite potential well.
- Potential well, the Bohr's theory and energy levels of the hydrogen atom.
- Computationally analyzing the Energy density/ distribution of energy of free electrons in metals, diffusion/heat equation, the Planck formula for blackbody radiation, a chaotic non-linear circuit, a non-linear simple pendulum.
- Computationally analyzing the frequency response of LCR circuits, Fermi-Dirac distribution of metals, specific heat of solids in the Debye approximation, random walk, Richardson-Dushman equation.
- Computationally analyzing various topics in miscellaneous areas of interest in Physics.

UNIT – I

Application of Mathematica to problems in Optics

Generation of Cornu's Spiral. Plot of the intensity – distance curve for: (1) a straight edge, (2) Fraunhofer diffraction at a single slit, (3) Fresnel diffraction at a single slit. Simulation of the diffraction patterns for: (1) a straight edge, (2) Fraunhofer diffraction at a single slit, (3) Fresnel diffraction at a single slit. Simulation of Newton's ring for reflected/transmitted mode of light.

UNIT – II

Application of Mathematica to problem solving in Quantum Mechanics

(1) Solving one dimensional Schrodinger equation for stationary states, (2) Solution of time independent Schrodinger equation for linear harmonic oscillator; Harmonic Oscillator Eigen functions, Harmonic Oscillator wave functions ,(3) Particle bound in an Infinite Potential Well: Energy Eigen values, wave functions.,(4)The Bohr theory and energy levels of the hydrogen atom

UNIT – III

Applications of Mathematica to miscellaneous areas in Physics

(1) Energy density/ distribution of energy of Free Electrons in Metals, (3) Numerical solution to the Diffusion/heat equation, (3).The Planck formula for blackbody radiation, (4) Phase Plot of a Chaotic non-linear circuit, (5) Study of the phase plots of a non-linear simple pendulum.

UNIT – IV

Computer Simulation using the Mathematica command Manipulate:

1. Frequency Response of LCR circuits.
2. Fermi-Dirac Distribution of Metals.
3. Specific Heat of Solids in the Debye Approximation.
4. Random walk.
5. Richardson Dushman equation.

UNIT - V

This unit will have questions based on tutorial problems covering all the four units. Some sample problems are:

1. The graphical depiction of the variation of the diameter of Newton's rings and variation of the square of the diameter of Newton's rings with the order of the rings.
2. The Poincare section in the chaotic domain of a non-linear simple pendulum.
3. The propagation of free wave packets. The spreading of the one dimensional, Gaussian wave packet can be demonstrated graphically.
4. Plotting of Hermite, Laguerre and LegendreP polynomials by Mathematica.
5. Energy Eigen values of a rigid rotator.
6. Solution of the Differential Equation of a of a LCR circuit using Laplace Transform.
7. Fourier Analysis of a square wave
8. Modeling and simulation of a predator and prey problem.

In addition to above the tutorial will also consist of solving problems given in the text and reference books.

SUGGESTED BOOKS AND RESOURCE SITES:

1. Programming in Mathematica: Roman Maeder, Addison Wesley.
2. Mathematica in the Laboratory: Samuel, Dick, Alfred Riddle, Douglas Stein, Cambridge University Press.
3. Introductory Statistics and Random phenomena: Manfred Denker and Wobor A. Woyczynski, Springer (India) Pvt. Limited.
4. Computational Physics: R. C. Verma, P. K. Ahluwalia and K.C. Sharma, New Age Publishers (1999)
5. Ajoy Ghatak, "Optics", 5th edition, Tata McGraw Hill Education Private Limited (2012)
6. Joseph Valasek, "Theoretical and Experimental Optics", John Wiley and Sons, Inc., New York (1949)
7. Francis S. Jenkins, Harvey E. White, "Fundamentals of Optics", 3rd edition, McGraw-Hill Book Company, Inc.(1957)
8. K. D. Moller, "Optics: Learning by Computing, With Examples Using MathCad", Springer-Verlag (2003)
9. Numerical Recipes in C ; Press W.H., Teukolsky S.A. Vellerling W.T. and Flannery B.P. (Cambridge Univ. Press 1992)
10. Simulation using Personal Computers: Carroll, J.M. (Prentice Hall, 1987)

11. www.wolfram.com
12. http://demonstrations.wolfram.com/HeatCapacityOfSolidsInTheDebyeApproximation/
13. http://demonstrations.wolfram.com/PlotsOfTheFermiDiracDistribution/
14. http://demonstrations.wolfram.com/FermiDiracDistributionsForFreeElectronsInMetals/
15. http://demonstrations.wolfram.com/FrequencyResponseOfAnLCRCircuit/

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Passing Marks - 14

PAPER IV

SPECIAL PAPER (b) ELECTROINCS – II

Course Outcome

The students are expected to acquire the knowledge of the following:

- Digital communication involving modulation.
- Concept of noise, networking, Multiplexing.
- Internal architecture and operation of Intel 8086 microprocessor, assembly language.
- Interfacing and interrupts in Intel 8086 system, elementary idea about Intel 80816, Intel 80286, and Intel 80386 to Pentium processors.

UNIT-I

Digital Communication

Pulse-Modulation Systems: Sampling theorem- Low pass and Band pass Signals, PAM, Channel Bandwidth for a PAM signal, Natural sampling, Flat-Top sampling, Signal recovery through Holding, Quantization of signal, Quantization, Differential PCM, delta Modulation, Adaptive Delta Modulation, CVSD.

Digital Modulation techniques: BPSK, DPSK, QPSK, PSK, QASK, BFSK, FSK, MSK.

UNIT-II

Noise in pulse code and Delta modulation systems: PCM transmission, calculation of Quantization noise, output-signal power, Effect of thermal noise, Output signal to noise ratio in PCM,DM, Quantization noise in DM, output signal power, DM output-signal –to Quantization- noise ratio. Effect of thermal noise in Delta modulation, output signal- noise ratio in DM.

Computer communication systems: Types of networks, Design of a communication network, examples TYMNET, ARPANET, ISDN, LAN.

Introduction to Mobile radio and satellites: Time division multiple Access (TDMA), Frequency Division Multiple Access (FDMA), ALOHA, Slotted ALOHA, Carrier Sense Multiple Access (CSMA) Poisson distribution, protocols.

UNIT-III

Introduction to 8086, Microprocessor chip, Internal Architecture, Introduction (Basics of) to Programming of 8086 and Assembly language. Programme development steps. Construction of machine code for 8086 Instructions, writing a programme for use with assembler, Assembly language program development tools.

Assembly Language Programming Technique: Simple sequence programmes. Basic idea of flags and jumps, While – Do, IF- THEN, IF –THEN-ELSE structure based simple programs. Writing and using Assembler Macros.

UNIT – IV

8086 System Connection Timings : 8086 Hardware Review, Addressing Memory and ports in microcomputer system , Basic Idea about Timing parameters, Minimum mode waveform and calculation for access time.

Interrupts : 8086 Interrupts and Interrupts response with some hardware applications.

Digital and Analog Interfacing of 8086 : Methods of parallel data transfer, single Handshake I/O , Double Handshake Data transfer. 8255 Handshake applications : Lathe control and speech synthesizer. Display and keyboard interfacing with 8279, D/A interfacing with microcompiler, A/D interfacing (introduction)

Elementary Idea about 80816, 80286, 80386 to Pentium processors

UNIT - V

This unit will have tutorial problems covering all the four units. Some sample problems are:

1. Explain the meaning of pulse code modulation. Draw one complete cycle diagram. Draw one complete cycle of some irregular waveform and show it is quantized using eight standard pulses.
2. Efficiency of PCM
3. Noise in PCM system
4. Signal to noise ratio in time division multiplexed PAM systems.
5. Program for creating a delay loop using 16 bit register pair.
6. Program for 8086 in Assembly Language using IF-THEN-ELSE structure.
7. Debugging Assembly Language Programs for 8086 μp with simple examples.
8. Assembly Language for interrupts procedure in 8086.

In addition to above the tutorial will also consist of solving problems given in the Text and References books.

Text and References Books

Principles of communication system	: Taub & Schilling (1994) II Edition
Communication systems	: Simon Haylein III Ed.
Microprocessors and Interfacing Programming and Hardware	: Douglas Hall 2nd Ed. (1992)
The Intel Microprocessor 8086/8088/ 80186/80286/80386/80486 Pentium and Pentium ProProcessor Architecture Programming and Interfacing	: Brey & Brey

ST. ALOYSIUS' COLLEGE (AUTONOMOUS), JABALPUR
DEPARTMENT OF PHYSICS
UNDER CBCS SYSTEM
2019 ONWARDS
M.SC. (PHYSICS) III & IV SEMESTER: PRACTICAL COURSE

Note: 1. Based on special paper I

2. Appropriate Other Experiments Can Be Added Based On Prescribed Syllabus In Both Labs A And B

LAB –A (CONDENSED MATTER PHYSICS –I & II)

MAX. MARKS: 50

MIN. MARKS: 18

(Preferably five experiments per semester to be performed by the students)

1. To find the Hall Coefficient, Carrier Density and Mobility of the Sample material (Ge).
2. To determine the Resistivity and the Energy Band Gap of Semiconductor (Ge) by Four Probe Method.
3. To find the refractive index of a polymer film and to study the variation of refractive index with wavelength of light source.
4. To find the refractive index of Sugar Solution to study the variation of refractive index with different molar concentration (Using Green Laser).
5. To determine the Plateau and optimal operating voltage of a GM Counter.
6. Determination of Beta Particle range and maximum Energy (by Half Thickness Method).
7. To Study the Variations of Counter rate for different materials (absorber of same thickness) with constant voltage.
8. To verify the Lambert – beer's law for different Concentration of $KMnO_4$ Solution using Spectrometer.
9. To Analyze material qualitatively using an FTIR Spectrophotometer.
10. To Measure the magnetic Susceptibility of $FeCl_3$ solution by Quincke's Method.
11. To find the crystallite size of Sample (CdS powder) using X-ray Diffractometer.
12. To find the miller indicies (hkl) of Sample (Known/Unknown) using X-ray Diffractometer.
13. To study crystal symmetry using Crystal model.
14. To measure the absorbance of different material using Spectro photometer.
15. Study of the dispersion relation for the monoatomic lattice- comparison with the theory.
16. Determination of the cut off frequency of the monoatomic lattice.
17. Study of the Dispersion relation for the diatomic lattice- acoustical mode and optical mode energy gap. Comparison with theory.
18. To Study ESR

ST. ALOYSIUS' COLLEGE (AUTONOMOUS), JABALPUR

DEPARTMENT OF PHYSICS

UNDER CBCS SYSTEM

2019 ONWARDS

M.SC. (PHYSICS) III & IV SEMESTER: PRACTICAL COURSE

Note: 1. Based on special paper II

2. Appropriate Other Experiments Can Be Added Based On Prescribed Syllabus In Both Labs A And B

LAB – B (MATHEMATICA – I & II)

MAX. MARKS: 50

MIN. MARKS: 18

(Preferably five experiments per semester to be performed by the students)

Analysis and Simulation of the following problems in Physics using Mathematica.

Addition and deletion of exercises can be done as per the need.

1. Write and execute a program to calculate and print roots of a quadratic $ax^2+bx+c = 0$ ($a\neq 0$) .
2. Write and execute a program in Mathematica to add and multiply two matrices.
3. Write and execute a program in Mathematica to determine the Eigen value of matrices.
4. Write and execute a program in Mathematica to determine the Eigen vector of matrices.
5. Converting graphics into 'jpeg' format. Exporting of images in 'jpeg' format.
6. Using DSolve to solve a differential equation and using Extract to obtain the solutions.
7. Using DSolve to solve a differential equation and plotting the solutions.
8. Study of " Harmonic Motion :- mx"+cx'+sx = 0";"c^2-4mk>0 , overdamped; c^2-4mk=0, critically damped; c^2-4mk<0, underdamped";
9. Phase Plot of a system undergoing linear Oscillations.
10. Potential Energy and Kinetic Energy diagram of the Linear Harmonic Oscillator.
11. Resonance Plots of a LCR circuit.
12. Study of Charging and Discharging in circuits with inductors, capacitors and resistors
13. Plot of the intensity – distance curve for a straight edge.
14. Plot of the intensity – distance curve for Fraunhofer diffraction at a single slit.
15. Plot of the intensity – distance curve for Fresnel diffraction at a single slit.
16. Simulation of the diffraction patterns for a straight edge.
17. Simulation of the diffraction patterns for Fraunhofer diffraction at a single slit.
18. Simulation of the diffraction patterns for Fresnel diffraction at a single slit.
19. Simulation of Newton rings for reflected light.
20. Obtaining the Energy Eigen values of a Particle bound in an Infinite Potential Well and plotting of the wave functions.
21. Obtaining the Energy Eigen values of the hydrogen atom by applying the Bohr theory and plotting of the energy level diagrams.
22. Computer Simulation of the Frequency Response of LCR circuits.
23. Computer Simulation of the Fermi-Dirac Distribution Plots of Metals.
24. Modeling and simulation of a predator and prey problem.

LAB –B (ELECTRONICS –I & II)

(Preferably five experiments per semester to be performed by the students)

1. Amplitude Modulation and Demodulation.
2. TDM PULSE Amplitude Modulation and Demodulation.
3. Study of PCM Receiver and Transmitter.
4. Study of satellite – C Band Receiver.
5. Study of AM – FM Receiver set.
6. Pulse position/ Pulse width Modulation and Demodulation.
7. FSK Modulation.
8. Microwave characterization and measurement.
9. Study of Motor speed control Interface and programming.
10. Temperature control using 8086.
11. Programs for Addition, Division, Subtraction, & Multiplication with 8085 μp system.
12. Programs for (using 8085) (a) To find Largest Number.
    (b) To find Smellers Number
13. Programme for Addition, Subtraction, Multiplication and Division with 8086.
14. Dielectric measurement of Solid/Liquids using Microwave.
15. SWR Reflection Coefficient Measurement.
16. Study of E Plane , H Plane, Magic Tees Bends.
17. Frequency Guide wavelength measurement.