M.Sc. PHYSICS (CHOICE BASED CREDIT SYSTEM)

REGULATIONS

ELIGIBILITY
A pass in B.Sc. Physics with Mathematics as an ancillary subject with minimum pass marks in Part-III Examination.

MASTER’S PROGRAMME
A Master’s programme consists of a set of Core courses and Optional courses.
Core courses are basic courses required for each programme.
Optional courses are offered by the other Departments of science faculty as well as by the Departments of other faculties. (Arts, Education and Indian Language).
The Optional subjects will be allotted by counseling by a committee of the respective Heads of the Department under the Chairmanship of the Dean of the Faculty.
A course is divided into five units to enable the students to achieve modular and progressive learning.

COURSE DURATION
The duration for completion of a two year Master’s Programme in any subject is four semesters.
An academic year is divided into two semesters, Odd semester and Even semester.
The normal semester periods are:
Odd semester: July to November (90 working days)
Even semester: December to April (90 working days)

COURSE AND CREDIT
The term credit is used to describe the quantum of syllabus for various programmes in terms of hours of study. It indicates differential weightage given according to the contents and duration of the courses in the curriculum design.
The number and distribution of credits for core courses will be decided by the respective faculties.
The minimum credit requirement for a two year Master’s Programme shall be 90.
The core courses shall carry 70 credits and the optional courses shall carry 20 credits.
A course carrying one credit for lectures will have instruction of one period per week during the semester. If four hours of lecture is necessary in each week for that course, the weightage will be 4 credits. Thus normally, in each of the courses, credits will be assigned on the basis of the lecture tutorials/laboratory work and other form of learning in a 18 week schedule on the basis that,
i) One credit of theory equals one lecture hour and
ii) One credit of practical equals three laboratory hours.
ATTENDANCE
Every teaching faculty handling a course shall be responsible for the maintenance of attendance register for candidates who have registered for the course.

The teacher of the course must intimate the Head of the Department at least Seven Calendar days before the last instruction day in the semester about the particulars of all students who have secured an attendance of less than 75%.

A candidate who has secured the attendance less than 75% shall not be permitted to sit for the End-Semester examination. However, it shall be open to the authorities to grant exemption to a candidate who has failed to obtain the prescribed 75% attendance for valid reasons on medical grounds upto 65%.

EXAMINATIONS
The internal assessment for each theory course carries 25% of marks and practical course carries 40% of marks which is based on two sessional tests and a variety of assessment tools such as seminar and assignment. The pattern of question paper will be decided by the respective faculties. The tests are compulsory. If for any valid reason, the student could not attend the test, the prerogative of arranging a special test lies with the teacher in consultation with the Head of the Department. But the student cannot repeat the internal assessment tests.

There will be an End Semester Examination for 75% of marks for 3 hours duration for each theory course and 60% of marks for practicals. The pattern of question paper will be decided by the respective faculties.

EVALUATION
The performance of a student in each course is evaluated in terms of Percentage of Marks (PM) with a provision for conversion to Grade Point (GP). The sum total performance in each semester will be rated by Grade Point Aggregate (GPA) while the continuous performance from the 2nd Semester onwards will be marked by Overall Grade Point Aggregate (OGPA).

MARKS AND GRADING
A student is deemed to have passed a particular paper provided he has secured a minimum of 50% in the end semester examination and an aggregate of 50% of marks in both sessional and end semester examination put together.

The percentage of marks obtained by a candidate in a course will be indicated in a letter grade. The term Grading system indicates a 10 point scale of evaluation of the performance of students in terms of marks, grade points, letter grade and class for each course and overall grade for the Master's Programme.
The successful candidates in the Core Subjects are classified as follows.

I - Class 60% marks and above in overall percentage of marks (OPM).

II - Class 50-59% marks in overall percentage of marks.

Candidates who obtained 75% and above but below 90% of marks (OPM) shall be deemed to have passed the examination in First Class (with Distinction) and who obtained 90% and above (OPM) shall be deemed to have passed the examination in First Class (Exemplary) provided he / she passes all the courses prescribed for the programme at the first appearance.

Only the candidates who obtained highest OPM in all the examinations at the first appearance are considered for ranking.

A student is considered to have completed a course successfully and earned the credits if he / she secured over all grades other than F. A letter grade F in any course implies a failure in that course. A course successfully completed cannot be repeated for the purpose of improving the Grade Point.

The F Grade once awarded stays in the grade card of the student and is not deleted even when he / she completed the course successfully later. The grade acquired later by the student will be indicated in the grade sheet of the Odd / Even semester in which the candidate has appeared for clearance of the arrears.

If a student secures F grade in the Project Work / Field Work / Practical Work / Dissertation, either he / she shall improve it and resubmit it if it involves only rewriting incorporating the clarification of the evaluators or he / she can re-register and carry out the same in the subsequent semesters for evaluation.
TRANSITORY REGULATIONS

Wherever there had been change of syllabi, examinations based on the existing syllabus will be conducted for three consecutive years after implementation of the new syllabus in order to enable the students to clear the arrears. Beyond that the students will have to take up their examinations in equivalent subjects, as per the new syllabus, on the recommendations of the Head of the Department concerned.

Details of Course with Credits
(2014 – 2015)

<table>
<thead>
<tr>
<th>Total Credits : 90</th>
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<tbody>
<tr>
<td>Course Code</td>
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<tr>
<td>FIRST SEMESTER</td>
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<tr>
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<td>YOGO 216</td>
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<td>THIRD SEMESTER</td>
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## Optional Courses Offered by the Department

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Theory</th>
<th>Credit</th>
<th>Internal Assessment Marks</th>
<th>End Semester Examination Marks</th>
<th>Total Marks</th>
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<tbody>
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<td></td>
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<td>L P C</td>
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<td>Optional</td>
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<tr>
<td>PHYC 314</td>
<td>Instrumentation</td>
<td>4 0 4</td>
<td>25</td>
<td>75</td>
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<tr>
<td>PHYC 324</td>
<td>Biophysics</td>
<td>4 0 4</td>
<td>25</td>
<td>75</td>
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</tbody>
</table>

## Optional Courses Offered to Other Science Departments

### In the II, III and IV Semesters

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Theory</th>
<th>Credit</th>
<th>Internal Assessment Marks</th>
<th>End Semester Examination Marks</th>
<th>Total Marks</th>
</tr>
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<tbody>
<tr>
<td></td>
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<td>L P C</td>
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<tr>
<td>PHYO 101</td>
<td>Classical Mechanics and Special Theory of Relativity</td>
<td>4 0 4</td>
<td>25</td>
<td>75</td>
<td>100</td>
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<tr>
<td>PHYO 201/301/401</td>
<td>Physics of the Earth</td>
<td>4 0 4</td>
<td>25</td>
<td>75</td>
<td>100</td>
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<tr>
<td>PHYO 202/302/402</td>
<td>Bio-Medical Instrumentation</td>
<td>4 0 4</td>
<td>25</td>
<td>75</td>
<td>100</td>
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<tr>
<td>PHYO 203/303/403</td>
<td>Energy Physics</td>
<td>4 0 4</td>
<td>25</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>PHYO 204/304/404</td>
<td>Bio Physics</td>
<td>4 0 4</td>
<td>25</td>
<td>75</td>
<td>100</td>
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### Internal Assessment Marks

#### Theory: Marks
- Internal Assessment Test-I : 10
- Internal Assessment Test-II : 10
- Assignment/Seminar : 05

**Total** 25

#### Practical: Marks
- Test I : 15
- Test II : 15
- Record : 10

**Total** 40
SYLLABUS

FIRST YEAR : FIRST SEMESTER

PHYC 101 - CLASSICAL AND STATISTICAL MECHANICS

Objective: Classical Mechanics is a handy tool in denoting that part of mechanics where the objects are too big or too small. The most important aspect of statistical mechanics is its Correlation with thermodynamics.

Unit-I: Mechanics of a Particle and System of Particles

Unit-II: Canonical transformations

Unit-III: Maxwell – Boltzmann Statistics

Unit-IV: Equipartition of Energy and Partition Function
 Principle of equipartition of energy – Partition function and their properties – Connection between the partition function and thermodynamic quantities – Mean values obtained from distribution law – Gibb’s paradox – Explanation and proof for occurrence of paradox – Sackur –Tetrode equation and its significance.

Unit-V: Quantum statistics
**Text Books and References:**


**PHYC 102 - ATOMIC AND MOLECULAR PHYSICS**

**Objective:** To understand the concept of atomic and molecular model through different theories. It also helps to understand the interaction between electromagnetic radiations such as microwave, IR and X rays with matter.

**Unit-I: Atom Model for Two Valence Electrons.**


**Unit-II: Magnetic and Hyperfine Structure**

Unit-III: Microwave and Infrared Spectroscopy


Unit-IV: Vibrational Raman Spectroscopy


Unit-V: Photoelectron and Photo Acoustic Spectroscopy.

Basic principles – Photoelectron spectroscopy – Design of X-ray PES and UV PES – Chemical information from PES - Basic concept of Augur electron spectroscopy – Principle of PAS – Block diagram of PAS – Different types of detecting systems – Application of PAS

Text books and References:

Objective: Mathematics has become an integral part of physics. This paper aims to provide extensive mathematical formalism for understanding and interpreting various physical problems.

Unit-I: Vector Analysis and Vector Spaces

Concept of gradient, divergence and curl - Gauss’s divergence theorem, Green’s theorem and Stoke’s theorem (statement and proof) - Orthogonal curvilinear coordinates - Expression for gradient, divergence, curl and Laplacian in cylindrical and spherical co-ordinates (Theory).

Linearly dependent and independent sets of vectors - Inner product (problems) - Schmidt’s orthogonalization process.

Unit-II: Special Functions

Beta and Gamma functions - Power series techniques in solving Bessel, Legendre, Hermite’s and Laguerre differential equations - Generating functions - Recurrence relations - Rodrigue’s formula - Orthogonal properties.

Unit-III: Partial Differential Equations

Solution of Laplace Differential Equation - Two dimensional flow of heat in cartesian and cylindrical co-ordinates. Solution of heat flow equation in one dimension - Solution of wave equation - Transverse vibrations of a stretched string (Theory).

Unit-IV: Fourier Analysis

Definition - Dirichlet’s theorem – Properties-convergence, integration, differentiation. Fourier sine and cosine series - Problems using the sine and cosine series. Physical applications - Full wave rectifier and forced vibration (Theory) - Complex form of Fourier series (Theory) - Expression for Fourier- Integrals.

Unit-V: Group Theory

Definition - Subgroups - Cyclic groups and abelian groups - Homomorphism and isomorphism of groups - Classes - Symmetry operations and symmetry elements - Representations of groups - Reducible and irreducible representations - Character tables for simple molecular types (C_{2v} and C_{3v} point group molecules)

Text Books and References:


**PHYP 104 - PRACTICAL – I**

*(Any Sixteen Experiments)*

1. Young’s modulus of a specimen plate- by Newton’s interference method.
2. Bi-prism on spectrometer- Wavelength (λ) and Refractive index (μ) of a liquid-using Laser source.
3. Charge of an electron- Spectrometer
4. Study of Hall effect in semiconductors.
5. Polarizability of Liquids- Hollow prism on spectrometer.
6. Hg-Cu spectrum- Hartmann’s constants and wavelength.
7. Planck’s constant.
8. Zeeman Effect.
9. Thermoluminescence
11. Microprocessor 8085 - Addition, Subtraction, Multiplication & Division
12. Microprocessor 8085 - Logical operation
13. Microprocessor 8085 - Solving expression, Factorial of N Numbers
14. Microprocessor 8085 - Code conversion
15. Microprocessor 8085 – Flashing and Rolling of Name display
16. Microprocessor 8085 – Stepper Motor
17. Microprocessor 8085 – ADC Interfacing
18. Microprocessor 8085 – DAC Interfacing
19. Microprocessor 8085 – Biggest and Smallest Numbers
20. Microprocessor 8085 – Ascending and Descending Order
FIRST YEAR : SECOND SEMESTER

PHYC 201 - MATHEMATICAL PHYSICS – II

Objective: To bring exposure to the mathematical concepts and interpreting various physical problems

Unit - I: Matrices
    Rank and inverse of a matrix - Symmetric and antisymmetric matrices - Hermitian and Skew Hermition matrices - Orthogonal and unitary matrices - Eigen values and Eigen vectors of the matrices - Cayley - Hamilton’s theorem (statement, proof and problems using the above methods)

Unit - II: Tensor Analysis
    Law of transformation of tensors - Algebraic operations - Rank of a tensor - Contravariant, covariant and mixed tensors - Symmetric and anti symmetric tensors - Kronecker delta (theory)
    Application of Tensor:
    Tensor forms of gradient, divergence, Laplace operator and curl - Application of tensor -dynamics of a particle - Stress and strain tensors (theory)

Unit - III: Complex Variables
    Complex analysis - Function of complex variables - Analytic function - Cauchy Riemann conditions - Cauchy’s integral theorem (statement and proof) - Residues and singularities - Cauchy’s residual theorem (statement and proof) - Evaluation of simple standard integral (problems using the above methods)

Unit - IV: Integral Transforms
    Fourier transforms - cosine and sine transforms - Linearity theorem - Parseval’s theorem - solution of differential equation. Laplace transforms - Definition - Linearity, shifting and change of scale properties. Inverse Laplace transforms – Definition - Problems - Solution of differential equation (problems using the above methods)

Unit - V: Green’s function
    Green’s function - Definition -Green’s function for one - Dimensional case - Properties of Green’s function - Solution of inhomogeneous differential equations \( \psi''=f(x) \) - Subject to the homogeneous boundary conditions and subject to the inhomogeneous boundary conditions (without involving derivatives) - Subject to the homogeneous boundary conditions and subject to the inhomogeneous boundary conditions (with involving derivatives).
Text Books and References:


PHYC 202 - CONDENSED MATTER PHYSICS

Objective: This paper provides the basic elements of the Physics of Solids and in particular the study of structure of crystalline solids and their physical properties.

Unit – I: Thermal Properties and Transport Properties
- Specific heat of solids – Dulong and Petit’s law - Einstein theory and Debye’s theory
- Conductivity due to electrons and phonons.

Unit – II: Free Electron Theory of Metals
- Free electron gas model– Free electron gas in one dimensional box and three dimensional box – Effects of temperature on the parameters of the free electron gas.
- Static properties of the metal: Thermionic emission and photoelectric effect.
- Transport properties of metals: Drude Lorentz theory of electrical conductivity and thermal conductivity.

Unit – III: Energy Bands in Solids
- Wave functions in periodic lattice and Bloch theorem – Kronig Penny model – Motion of electron in one dimension – Negative effective mass and holes – Physical basis of the effective mass values – Easy limiting cases of the true periodic potential- Nearly free electron approximation – Tight - binding approximation – Constant energy curves and surfaces – Overlapping of allowed zones – Distinction between metals, insulators and semiconductors.
Unit – IV: Dielectrics

Unit – V: Superconductivity

Text Books and References:

PHYC 203 - ELECTROMAGNETIC THEORY AND MODERN OPTICS

Objective: In this paper the ideas of electromagnetic theory and modern optics are integrated within a unfired framework using electromagnetic theory as its foundation, to make the students aware of the most important methods of optical analysis.

Unit – I: Maxwell’s Equations and E.M. Waves
Maxwell’s equation and their empirical basis - Derivation and physical significance - Electromagnetic energy - Poynting theorem - Poynting vector - The wave equation - Plane electromagnetic waves in free space - Non-conducting( isotropic dielectric) and conducting medium.

Unit – II: Reflection and Refraction of E.M Waves
Boundary conditions at the surface of discontinuity - Reflection and refraction of e.m waves at the interface of non - Conducting media - Kinematic and dynamic properties - Fresnel’s equation - Electric field vector ‘E’ parallel to the plane of incidence and perpendicular to the plane of incidence - Reflection and transmission co-efficients at the
interface between two non-Conducting media - Brewster’s law and degree of polarization - Total internal reflection.

**Unit – III: Application of E.M Waves**

Dispersion - Normal and anomalous dispersion - Various dispersion relations - Dispersion in gases, liquids and solids - Scattering - Theory of scattering of e.m waves to determine scattering parameter (Rayleigh, Resonance and Raman).

**Relativistic Electrodynamics**

Lorentz transformation - Consequences - Transformation of differential operators - Invariance of D’Alembert’s operator - Four vector - Lorentz transformation of space and time in four vector form - Transformation of e.m potential A and φ - Lorentz condition in covariant form - Invariance of Maxwell’s field equation in vector form.

**Unit – IV: Interference**

Two beam interferometry - Michelson’s interferometer - Theory – Applications

**Multi beam Interferometry**

FP Etalon - LG plate - Theory, expression for resolving power - Determination of specific charge of an electron.

**Coherence**

Types of coherence - Holography - Principle of holography - Characteristics - Recording and reconstruction - Classification - Applications - Non - Destructive testing.

**Unit – V: Diffraction**

Fresnel, Fraunhoffer diffraction (brief explanation) - Application of Fraunhoffer - Diffraction to rectangular and circular aperture - Fresnel’s diffraction by rectangular aperture - Babinet’s Principle.

**Plasma Physics**

Text Books and References:


**PHYC 204 - MICROPROCESSORS AND INTERFACING DEVICES**

**Objective:** This paper presents an extensive knowledge about the architecture, assembly language and interfacing of Intel 8085 and Advanced microprocessors.

**Unit-I: Introduction to 8085**

**Unit-II: Introduction to Assembly Language Program**
Instruction set: Data transfer instructions - Addressing modes – Arithmetic operations – Logical operations – Branching and machine control operations. Writing assembly language programs: Looping, counting and indexing. Translation from assembly language to machine language – 16 bit data transfer and arithmetic instructions – Arithmetic operations related to memory. Vectored and non-vectored interrupts.

**Unit-III: Introduction to 8086**

**Unit – IV: Introduction to High End Processor**
Unit – V: Introduction to Interfacing Devices
Basic concepts of programmable device - 8255 Programmable Peripheral Interface (PPI) – 8254 Programmable Interval Timer (PIT) – 8257 Direct Memory Access (DMA) controller – 8259 Interrupt controller. Basic concepts of serial I/O and data communication – 8251 Universal Synchronous Asynchronous Receiver Transmitter (USART).

Text Books and References:

PHYP 205 - PRACTICAL – II
(Any Sixteen Experiments)
1. Michelson Interferometer – Wavelength Determination.
2. Energy gap – Four Probe Apparatus.
3. Elastic constants of Glass- Cornu’s interference method (Hyperbolic fringes).
4. Solar Spectrum
5. Thermistor characteristics-Band gap energy
6. Reflection grating-Spectrometer
7. Ultrasonic diffractometer – Velocity and compressibility of liquids
10. Magnetostriction
11. Numerical Aperture and Acceptance Angle-Fibre Optics
12. Microprocessor 8086 I – Addition and Subtraction (16 & 32 bits)
13. Microprocessor 8086 II – Multiplication and Division (16 & 32 bits)
14. Microprocessor 8086 - Biggest and Smallest Numbers
15. Microprocessor 8086 - Code conversion
16. Microprocessor 8086 - Solving expression, Factorial of N Numbers
17. Microprocessor 8086 – Sum of elements in an array and factorial
18. Microprocessor 8086 – Sorting of N Elements (Ascending and Descending Order)
19. Microprocessor 8086 – String Operations
20. Wave form generations using 8086.
Objective: This paper makes the students to understand the various kinetics involved in advanced physics using approximation methods.

Unit – I: Discrete Eigen Values: Bound States

Unit – II: Representation Theory

Unit – III: Approximation Methods: Perturbation

Unit – IV: Approximation Methods: Variation and WKB Approximation

Unit – V: Scattering Theory
Kinematics of the scattering process – Differential and total cross section – Wave mechanical picture of scattering – Green’s function – Expression for scattering amplitude –
Born’s Approximation – Validity of Born’s approximation – Application to screened coulomb potential.


Text Books and References:

3. Quantum Mechanics, G.S. Chadda, New age International, 2005
4. Quantum Mechanics, V. Devanathan, Weily Eastern, 2005

PHYC 302 - MATERIALS SCIENCE

Objective: To make the students to understand the properties of materials with their structure at the electronic, atomic and micro level as well as their behaviour of variety of materials.

Unit – I: Crystal Growth and Thin Films


Unit – II: Defects

Phase diagram – Basic principle – Simple binary systems – Solid solutions -Eutectic systems – Application

Point defects - Schottky and Frenkel defects – Number of defects as a function of temperature – Diffusion in metals – Diffusion and ionic conductivity in ionic crystals.


**Unit – III: Optical Properties and Ferro Electrics**


**Unit – IV: Magnetism**


**Unit – V: Elastic Behaviour, Polymer and Ceramics**

Anelastic and viscoelastic behaviour – Atomic model of elastic behaviour – Rubber like elasticity – An elastic deformation - Relaxation process – Model for viscoelastic behaviour.


Ceramic: Ceramics phases – Structure of ceramics phases – Classes – Effect of structure on the behaviour of ceramic phases – Composites

**Text Books and References:**

PHYC 303 - MICROCONTROLLER AND ITS APPLICATION

Objective: This paper gives a systematic, step by step approach to cover various uses of microcontroller 8051, assembly language programming and interface

Unit – I: Introduction to Microcontroller
Introduction to microcontroller and embedded system – 8051 microcontroller : Pin configuration, Architecture and Key features.

Unit – II: Assembly Language Programming
8051 data types and directives - Data transfer instructions - Addressing modes – Jump, Loop and Call instructions and programs - Arithmetic instructions and programs – Logical instructions and programs – Single bit instructions and programs.

Unit – III: 8051 Serial Communication
Basics of serial communication – Half and full duplex transmission- Asynchronous serial communication –Data communication classification.

Unit – IV: Interfacing to External Memory
Semiconductor memory-memory capacity-Organization-Speed-ROM-PROM-EPROM-Flash memory EPROM-Mask ROM. RAM-Static RAM- Dynamic RAM-Non-volatile RAM.

Unit – V: Applications of 8051 Microcontroller

Text Books and References:
PHYP 304 - PRACTICAL – III
(Any Sixteen Experiments)

1. Low field Hysteresis
2. Susceptibility of liquids using Guoy-Balance
3. Susceptibility of liquids by Quinke’s method
4. Photo elastic constant
5. Hysteresis loop tracer
6. Cu-Salt (visible) Spectrum
7. Molecular constants-CN Band
8. Channel Spectrum
10. Ultrasonic velocity of liquid mixtures- Interferometer
12. G.M. Counter characteristics
13. Microcontroller 8051 Experiment-I (Addition and Subtraction and Logical operations)
14. Microcontroller 8051 Experiment-II (Multiplication and Division and Solving expressions)
15. Microcontroller 8051 Experiment-III (Logical operations, 1’s and 2’s compliment)
16. Array Operations-I Microcontroller 8051 (Sum of elements, biggest and smallest numbers)
17. Array Operations-II Microcontroller 8051 (Ascending and descending order)
18. Microcontroller 8051 - Code conversion
19. Microcontroller 8051 – ADC interfacing
20. Microcontroller 8051 - Stepper motor interfacing
Objective: To bring exposure to the kinetics of relativistic and non-relativistic concept.

Unit – I: Time Dependent Perturbation


Unit – II: Theory of Angular Momentum

Angular momentum of system of particle – Commutation rules – Eigen value spectrum – Matrix representation of J in the Jm> basis – Pauli’s spin matrices – Spinors density matrix – Addition of angular momentum – Triangular rule – Coupled and uncoupled representation – CG coefficient for \( j_1 = j_2 = \frac{1}{2} \).

Unit – III: Quantum Theory of Valency


Unit – IV: Relativistic Quantum Mechanics


Unit – V: Field Quantization


Basic ideas of Feynman diagram – World line – Space – Time - Feynman graph for scattering of an electron by a potential.
Text Books and References:

PHYC 402 - NUCLEAR AND PARTICLE PHYSICS

Objective: This paper is designed to impart the general properties of nuclei, nuclear forces and various models developed. It also provides the knowledge on the nuclear reactions, nuclear energy, elementary particles and symmetry schemes.

UNIT – I: Nuclear Properties and Mass Spectrographs
Nuclear mass and binding energy- Variation of binding energy with mass - Spin and parity - Isospin- Semi empirical mass formula - Stability of nuclei - Mass parabolas for different types of nuclei.

UNIT – II: Nuclear Force and Models
Characteristics of nuclear force - Meson theory and Yukawa’s potential - n-p scattering at low energies (scattering length, phase shift, spin dependence, coherent scattering, shape independent effective range theory)- similarity between n-n and p-p forces- exchange forces- non-central forces- theory of ground state of deuteron.
Nuclear models: Degenerate gas model- liquid drop model - Shell model and collective model.
UNIT – III: Nuclear Reactions and Neutron Physics

Types of nuclear reactions - Conservation laws for nuclear reactions - Kinematics of nuclear reactions- Q-value-nuclear reaction cross section- Compound nucleus theory - Breit-Wigner one level formula for scattering.


UNIT – IV: Nuclear Energy

Nuclear fission- Energy release in fission reaction - Distribution of fission products-neutron emission in fission - Fissile and fertile materials - Nuclear fission and liquid drop model -Bohr Wheeler theory.

Nuclear chain reaction - Four factor formula - Nuclear reactors - Critical size of a reactor - Reactor materials - Classification of reactors.

UNIT – V: Elementary Particles and Symmetry Schemes


Quark model, flavours and colours - Isospin and SU(2) symmetry - Eight-fold way and supermultiples- SU(3) symmetry schemes for boson octet, baryon octet and baryon decuplet.

Text Books and References:

Objective: This paper deals with the different regions of the electromagnetic spectrum for understanding the symmetry of molecular groups, molecular structure, the nature of bonding and its utility in conformation analysis.

Unit-I: Group Theoretical and Force field studies of polyatomic molecules.
Symmetry of polyatomic molecules and molecular vibrations - Selection rules for Raman and IR vibrational normal modes - calculation of normal modes for Raman and IR active to C\(_2\)V and C\(_3\)V point groups by group theoretical methods.
Representations for molecular vibrations in internal and symmetry coordinates - calculation of F and G matrices - Normal coordinate analysis for simple polyatomic molecules (H\(_2\)O and NH\(_3\)).

Unit-II: NMR and NQR Spectroscopy
Nuclear Magnetic Resonance Spectroscopy: General principles of NMR - Quantum theory of NMR - design of CW NMR spectrometer - chemical shift - application of chemical shift to molecular structure.
Nuclear quadrupole resonance spectroscopy - Definition of Nuclear quadrupole moment - asymmetry parameter-Integral spins - Fundamental requirements of NQR spectroscopy - Block diagrams of NQR Spin spectrometer-continuous wave oscillators-principle of super regenerative oscillators - pulsed RF detector - Application of NQR with special reference to chemical bonding.

Unit-III: ESR Spectroscopy.
Origin of electron spin resonance and resonance condition – Thermal equilibrium and relaxation – Quantum mechanical theory of ESR – Representation of ESR spectrometer – Requirements of ESR spectrometer – Block diagram of a simple ESR spectrometer – Hyperfine structure splitting in isotropic systems involving more than one nucleus – contributions to hyperfine coupling – ESR of triplet states – application of ESR to Solid State Physics (crystal defects) Biological applications.

Unit-IV: Mossbauer Spectroscopy.
Unit-V: Fluorescence and Phosphorescence Spectroscopy.


Text Books and References:

PHYC 404 - PHYSICS OF NANOMATERIALS

Objective: Nano Sciences, the emerging area of science brings together physics, chemistry and biology to create a scientific discipline of almost infinite potential. Physics of nano materials is concerned with the study, creation, manipulation and applications of materials at nanometer scale.

Unit – I: Introduction

Unit – II: Special Nanomaterials

Unit – III: Properties
Physical properties of nanomaterials: Melting points, Specific heat capacity and lattice constants – Mechanical properties – Optical properties:-Surface Plasmon Resonance –
Quantum size effects – Electrical property: Surface scattering, charge of electronic structure, Quantum transport, effect of microstructure: Ferroelectrics and dielectrics – Variation of magnetism with size-Super para magnetism-Diluted magnetic semi conductor.

**Unit – IV: Synthesis**


**Unit – V: Characterization and Applications**


**Text Books and References:**


**PHYP 405 - PRACTICAL – IV**

*(Any Sixteen experiments)*

1. Spectrophotometer
2. Co-efficient of linear expansion-Interference Method.
3. R.F. Oscillator- Dipole moment of Liquids
4. Susceptibility of Salt solutions/ Solids-Guoy method
5. Susceptibility of liquid mixture- Quinckes method-Calculation of Bohr magneton.
6. Phase diagram-Two component system.
7. Molecular constants – ALO Band
8. Molecular constants- CN Band.
10. Optical rotation of quartz.
11. G.M. Counter - Absorption co-efficient of a foil.
12. F.P. Etalon.
13. Dielectric of Solidsm
15. Stark Effect.
17. 8051 Micro controller - Setting bits and Masking bits in an 8-bit number.
18. Microcontroller 8051 - Generate a delay.

**OPTIONAL COURSES OFFERED BY THE DEPARTMENT**

**OPTIONAL**

**PHYC 314 : INSTRUMENTATION**

**Objective:** This paper highlights the concept of instrumentation and functioning of various analytical instruments in diversified fields.

**Unit – I: Transducers**
Basic functional elements of a measuring system-Transducers: Definition-Parts-Classification-Types of primary sensing element.
- Piezo electric transducers: Principle, theory and working of piezo electric crystals.

**Unit – II: Digital Instrumentation**

**Unit – III: Analytical Instrumentation**
Principle, working, Instrumentation and applications of UV-Vis Spectrophotometer, ICP-AES, (Inductive coupled plasma-Atomic emission spectroscopy), SEM (Scanning Electron Microscope) and AFM (Atomic Force Microscopy).
Unit – IV: Bio-Medical Instrumentation


Principle, block diagram and functioning of ECG, EEG and EMG.

Unit – V: Medical Imaging Instrumentation


Computed Tomography: Principle-CAT scanning-Instrumentation-Contrast scale-Scanning components.

Text Books and References:

2. Electronic measurements and Instrumentation, Dr.Rajendra Prasad, Khanna Publishers, 2002

PHYC 324 : BIOPHYSICS

Objective: This paper helps to understand the applications of various microscopic tools in cell biology. This paper helps the reader to understand the fundamentals of macromolecular
structure and the analytical techniques in characterizing biomolecular interactions and its structure.

**Unit I: Cell Organization**

Cell as the basic structural unit- Origin & organization of Prokaryotic and Eukaryotic cell- Cell size & shape- Fine structure of Prokaryotic & Eukaryotic cell organization (Bacteria, Cyanobacteria, plant & Animal cell)- Internal architecture of cells- cell organelles-compartment & assemblies membrane system- Ribosome- Polysomes- Lysosomes- Peroxisomes- Connection between cell & its environment- Extracellular Matrix.

**Unit II: Tools in Cell Biology**


**Unit- III: Macromolecular structure**

Nucleic acid structure: Chemical structure of the nucleic acid - Conformational possibilities of monomers and polymers- Double helix structure of DNA- Polymorphism of DNA- DNA nanostructures and the structure of transfer RNA.


**Unit-IV: Separation Techniques**


**Unit V: Optical & Diffraction Techniques.**

Circular Dichroism and optical rotator dispersion:- Plane, circular and elliptical polarization of light- Absorption by oriented molecules- Dichroic ratio of proteins and nucleic acids- Circular dichroism (CD) - optical rotatory dispensor (ORD) - Relation between CD and ORD- Application of ORD in conformation and interactions of biomolecules.

Crystallization of proteins- preparation of heavy metal derivatives- Patterson synthesis- isomorphous replacement methods- structure factors of centro-symmetric and non-

**Text Books and References:**


**OPTIONAL COURSES OFFERED TO OTHER SCIENCE DEPARTMENTS IN THE II, III and IV SEMESTERS**

**PHYO 101: CLASSICAL MECHANICS AND SPECIAL THEORY OF RELATIVITY**

**Objective:** The contents emphasize the advantage of energy representation in dynamics and the macroscopic properties in terms of microscope manifestations.

**Unit – I**


**Unit – II**


**Unit – III**

Unit – IV:

Newtonian relativity- Michelson Morley experiment- Lorentz transformation and Consequences- relativity of simultaneity- the Lorenz-Fitz Gerald length contraction, Time dilation- Addition velocities.

Unit – V

Variation of moss with velocity, Moss energy relation, Minkowski four dimensional contiumum- Four vectors Compton scattering.

Text Books and References:


PHYO 201/301/401 : PHYSICS OF THE EARTH

Objective:
To understand the physical structure and behavior of the earth as well as geomagnetic properties of rocks in the Earth’s crust.

Unit – 1: Solar System
The earth and the solar system – Important physical parameters and properties of the planet earth; Stress and Strain, Wave and motion, Seismic waves. Travel time Tables and Velocity – Depth curves – Variation of Density within the Earth.
Unit – 2: Gravitation

Unit – 3: Thermal history of earth

Unit – 4: Elastic properties

Unit – 5: Geomagnetism and Palaeomagnetism

Text Books and Reference:

PHYO 202/302/402 : BIO-MEDICAL INSTRUMENTATION
Objective:
To understand the working principles of various instruments in medicine and to update the knowledge of various imaging techniques and physiological parameters for the readers.
UNIT – I: Bio-Electric Potentials
  Resting and action potentials – Propagation of action potentials – Bioelectric potentials- Electrocardiogram (ECG) – Electroencephalogram (EEG) – Electromyogram (EMG) – Electroretinography(ERG) - Electrooculography (EOG)

UNIT – II: Bio-Potential Electrodes
  Biopotential Electrodes – Types of Electrodes -Microelectrodes – Body surface electrodes – Depth and Needle electrodes- Chemical electrodes – Distortion in measured bioelectric signals using electrodes-Electrode paste

UNIT – III: Imaging Equipments
  Ultrasonic Imaging-Reflection-Scattering-A mode display-B mode display-T-M mode display-Ultrasound imaging instrumentation-Biomedical applications- Magnetic Resonance Imaging (MRI)-Principle-Instrumentation-Advantages of MRI over other medical imaging techniques- Thermography-Endoscopy

UNIT – IV: Measurement of Physiological Parameters

UNIT – V: Laser in Medicine

Text Books and References:

PHYO 203/303/403 : ENERGY PHYSICS

Objective: This paper deals with the practical usage of solar energy in various forms and other alternative energy sources.
UNIT – I: Conventional Energy Sources
Energy sources and their availability – Various forms of energy – Renewable and conventional energy systems – Comparison – Coal, oil and natural gas.

UNIT – II: Solar Energy

UNIT – III: Thermal Energy Storage

UNIT – IV: Photo Conversion
Photovoltaic conversion - Principle and working of solar cells - Conversion efficiency - Single crystal and Polycrystalline silicon - Cadmium sulphide - Cadmium telluride.

UNIT – V: Other Forms of Energy

Text Books and References :


PHYO 204/304/404 : BIOPHYSICS

Objective: This paper is aimed at to studying the analytical separation and spectroscopic techniques for characterizing biomolecular interactions.

Unit – I: Separation Technique
Electrophoresis-Moving boundary electrophoresis- Zone electrophoresis- Low voltage electrophoresis- High voltage electrophoresis- Gel electrophoresis- Poly acrylamide gel electrophoresis (PAGE) - Sodium dodecyl sulphate poly acrylamide gel electrophoresis (SDS-PAGE) - Iso electric focusing electrophoresis- Continuous flow electrophoresis.

**Unit – II: Centrifugation and Laser**

Centrifugation- Basic principles of sedimentation - Relative centrifugal force (RCF)- Sedimentation Rate - Svedberg unit or Sedimentation Coefficient - Types of Centrifugation - Analytical Centrifugation - Ultra centrifugation - Preparative centrifugation Differential centrifugation – Density gradient centrifugation-Rate zonal centrifugation - Isopycnic centrifugation.


**Unit – III: Tools in Cell Biology**

Light microscopy- elementary geometrical optics, Limits of resolution. Types of microscopy- Bright field microscopy- Phase contrast microscopy-Fluorescence microscopy- Polarising Microscopy- Electron Microscopy- Scanning electron microscope (SEM) - Transmission electron microscope (TEM) - Preparation of the specimen for electron microscopy - Atomic force microscope.

**Unit – IV: Spectroscopy-I**

Electromagnetic radiation- Beer-Lambert’s law- Calorimeter- Spectrometer- Single and Double beam Spectrophotometer- Ultraviolet and visible Spectroscopy-Origin and theory of UV Spectra –Instrumentation- Applications

Fluorescence spectroscopy- Principles- Single and Double beam spectrofluorimeter – Applications.

**Unit – V: Spectroscopy-II**

Introduction - Basic concept of IR spectroscopy-IR spectrometer- Infrared Spectroscopy Basic concept of IR Spectroscopy - IR Spectrometer- Principle and instrumentation- Sample handling techniques- FTIR- principle –Instrumentation – Applications

Introduction-Basic concept of Raman Spectroscopy-Raman Spectrometer- Instrumentation and working – Applications
Text Books and References:
1) Biophysics, Vasantha Pattabhi, N. Gautham, Narosa Publishing, 2009
2) Biophysics P.S. Mishra, VK Enterprises, 2010
3) Biophysics, M.A. Subramanian, MJP Publishers, 2005
4) Bioinstrumentation, L. Veerakumari, MJP Publishers, 2006