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 2^{nd} 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.

Marks	Grade Points	Letter Grade	Class
91+	10	S	Exemplary
85-89	9.0	D++	Distinction
80-84	8.5	D+	Distinction
75-79	8.0	D	Distinction
70-74	7.5	A++	First Class
65-69	7.0	A+	First Class
60-64	6.5	A	First Class
55-59	6.0	B	Second Class
50-54	5.5	C	Second Class
49 or Less		F	Fail

The successful candidates in the Core Subjects are classified as follows.

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

II - Class 50-59% marks in over all 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)

Total Credits : 90

Course Code	Course Title	Hours	Credit	Inter. Mark	Exter. Mark	Total
FIRST SEMESTER						
PHYC 101	Classical and Statistical Mechanics	4	4	25	75	100
PHYC 102	Atomic and Molecular Physics	4	4	25	75	100
PHYC 103	Mathematical Physics-I	4	4	25	75	100
ENGE 116	Soft Skill Communication	4	4	25	75	100
PHYP 104	Practical – I	9	3	40	60	100
SECOND SEMESTER						
PHYC 201	Mathematical Physics - II	4	4	25	75	100
PHYC 202	Condensed Matter Physics	4	4	25	75	100
PHYC 203	Electromagnetic Theory and Modern Optics	4	4	25	75	100
PHYC 204	Microprocessor and Interfacing Devices	4	4	25	75	100
PHYP 205	Practical - II	9	3	40	60	100
YOGO 216	Optional – History and Development of Yoga and Yoga in Physical Education	4	4	25	75	100
THIRD SEMESTER						
PHYC 301	Quantum Mechanics – I	4	4	25	75	100
PHYC 302	Materials Science	4	4	25	75	100
PHYC 303	Microcontroller and its Application	4	4	25	75	100
PHYP 304	Practical - III	12	4	40	60	100
PHYC 314	Instrumentation	4	4	25	75	100
ZOOO 315	Optional - Environmental Science	4	4	25	75	100
FOURTH SEMESTER						
PHYC 401	Quantum Mechanics – II	4	4	25	75	100
PHYC 402	Nuclear and Particle Physics	4	4	25	75	100
PHYC 403	Spectroscopy	4	4	25	75	100
PHYC 404	Physics of Nanomaterials	4	4	25	75	100
PHYP 405	Practical – IV	12	4	40	60	100
PHYP 406	Project	0	4	0	60	100
	Viva-Voce	0		0	40	

OPTIONAL COURSES OFFERED BY THE DEPARTMENT

Subject Code	Theory	Credit			Internal Assessment Marks	End Semester Examination Marks	Total Marks
		L	P	C			
Optional							
PHYC 314	Instrumentation	4	0	4	25	75	100
PHYC 324	Biophysics	4	0	4	25	75	100

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

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

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

Mechanics of a Particle and System of particles – Constraints – Degrees of freedom – Generalized coordinates and its advantages – Hamilton's variational principle – Lagrange's equation of motion – D'Alembert's principle – Applications of Lagrange's equation of motion – Linear harmonic oscillator and simple pendulum. Cyclic co-ordinates – Equivalence of Lagrange's and Newton's equations – Principle of least action.

Unit-II: Canonical transformations

Canonical transformation and Conditions for transformation to be canonical with examples – Hamilton-Jacobi method. Hamilton's principal function – Solution of harmonic oscillator problem by Hamilton-Jacobi method – Poisson brackets, Properties and Invariance of Poisson brackets, Equation of motion in Poisson bracket – Small oscillations – Normal modes and Normal Coordinates – Free vibrations of a linear triatomic molecule.

Unit-III: Maxwell – Boltzmann Statistics

Postulates of kinetic theory of gases – Maxwell-Boltzmann distribution of velocities – Derivation of Maxwell – Boltzmann distribution equation – Significance of Maxwell-Boltzmann equation – Phase Space – Ensembles and their types – Liouville's theorem – Statement and Proof.

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

Differentiation of B-E and F-D particles – Derivations of B-E and F-D distributions – Comparison of M-B,B-E and F-D statistics – Black body radiation and the Planck radiation law – Derivation with explanation – Ideal Bose gas – Gas degeneracy – Derivation - Bose Einstein Condensation – Derivation with explanation (Example: Liquid Helium)

Text Books and References:

1. Introduction to Classical Mechanics, R.G.Takwale and P.S.Puranik, Tata Mc Graw Hill, New Delhi, 1979.
2. Classical Mechanics of Rigid Bodies, Kiran C.Guta, New Age Publications, 1997.
3. Classical Mechanics, B.D.Gupta and Satya Prakash, Keder Nath Publishers, Meerut, 2004.
4. Statistical Mechanics, R.K.Agarwal and Melvin Eisner, New Age Publisher, 2011.
5. Statistical Mechanics and Properties of Matter, E.S.R.Gopal, The Mc Millan Company of India Ltd., 1976.
6. Quantum Mechanics, A.K.Ghatak and S.Lokanathan, The Mc Millan Company.
7. A Text Book of Quantum Mechanics, P.M. Matheews and Venkatesan, Tata Mc Graw Hill Company, Ltd., 1976.
8. Classical Mechanics, H.Goldstein, Addision Wesley Publishing Company, Massachusetts, 1961.
9. Statistical and Thermal Physics, F.Reif, Mc Graw Hill Book Co., 1992.
10. Thermodynamics, Sears, Addison, Wesley Publishing Company, 1969.

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.

Sommerfield's elliptical orbits and space quantization – Total energy of a stationary state – Hydrogen fine structure – Dirac electron – Fine structure and the spinning electron – Doublet fine structure alkali metals – Selection rules for doublet – Intensity rules for fine structure doublet – Spinning electron and the vector atom model – Electron spin – Orbit interaction – Penetrating and non-Penetrating orbits, Atom model for two valence electrons – Coupling schemes for two electrons – Interaction energies for LS coupling – Lande's interval rule – j-j coupling in the carbon group of elements – Branching rule – Selection rule – Intensity relations.

Unit-II: Magnetic and Hyperfine Structure

Zeeman Effect in single and two valent atomic systems – Influence of varying magnetic field strengths – Hyperfine structure of spectral lines – Nuclear Zeeman effect. Back - Goudsmit effect – Determination of nuclear moments – Anomalous Zeeman Effect. Paschen - Back effect– Zeeman patterns for typical spectral transitions.

Unit-III: Microwave and Infrared Spectroscopy

Microwave spectroscopy – Rotational spectra of diatomic and polyatomic molecules – Symmetric and asymmetric molecules – Techniques and instrumentation – Infrared spectroscopy – Vibrational study of diatomic molecules – Simple gaseous polyatomic molecules – Vibrational frequencies and qualitative analysis – Quantitative IR analysis – Determination of bond moment and bond length – Detection of interstellar atoms and molecules – IR spectrometer – Elementary ideas of FTIR.

Unit-IV: Vibrational Raman Spectroscopy

Raman effect – Raman shift – Definitions – Observation of Raman spectra – Raman spectrometer- Quantum theory of Raman effect – Probability of energy transition in Raman effect - Vibrational Raman spectra – Structure determination from Raman and IR Spectroscopy – General features of electronic spectra of diatomic molecules – Frank-Condon principles – Electronic states – Configuration of some typical molecules.

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:

1. Spectroscopy and Molecular Structure, G.W. King, Holt, Rinehart and Winton, New York, 1964.
2. Fundamentals of Modern Physics, Eisberg. Robert, John Wiley and Sons, New York, 1961.
3. Spectroscopy Vol (I-II), Stanley D. Walker, H. Straw, Macmillan, 1962.
4. Fundamental of molecular spectroscopy, C.N Banwell, Tata Mc Graw Hill, 1972.
5. Spectroscopy (vol.II), B.P.Straugham and S.Walker, Chapman and Hall,1976.
6. Elements of Spectroscopy, S.L Gupta, V.Kumar and R.C.Sharma, Pragathi and Prakashan Publication company Meerut, 2006.
7. Spectroscopy (Atomic and Molecular), Gurdeep Chatwal and Sham Anand, Himalaya Publication house, 2004.
8. Vibrational Spectroscopy, D.N.Sathyanaryana, New Age International (P) Ltd., 1996.

PHYC 103 - MATHEMATICAL PHYSICS – I

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:

1. Mathematical Physics, B.D. Gupta, Vikas Publishing House Pvt. Ltd, 1995.
2. Mathematical Physics, B.S.Rajput, 20th Edition, Pragati Prakashan, 2008.

3. Mathematical Physics, H.K. Dass and Rama Verma, S.Chand and Company Ltd, 2010.
4. Mathematical physics, P.K. Chattopadhyay, Wiley Eastern Limited, 1990.
5. Introduction to Mathematical physics, Charlie Harper, Prentice Hall of India Pvt.Ltd, 1993.
6. Applied Mathematics for Engineers and Physicists, L.A. Pipes and L.R. Havevill, McGraw Hill Publications Co., 3rd Edition, 1971.
7. Theory and Problems of Laplace Transforms, Murray R. Spigel, Schaum's outline series, McGraw Hill, 1986.
8. Matrices and Tensors in Physics, A.W. Joshi, Wiley Eastern limited, 3rd Edition, 1995.

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
10. Krishnan Torsion Balance.
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 - Contravarient, 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:

1. Mathematical Physics, B.D. Gupta, Vikas Publishing, 1995.
2. Mathematical Physics, B.S. Rajput, 20th Edition, Pragati Prakashan, 2008.
3. Mathematical Physics, H.K. Dass and Rama Verma, Chand and Company Ltd, 2010.
4. Mathematical physics, P.K. Chattopadhyay, Wiley Eastern Limited, 1990.
5. Introduction to Mathematical Physics, Charlie Harper, Prentice Hall of India Pvt. Ltd, 1993.
6. Applied Mathematics for Engineers and Physicists, L.A. Pipes and L.R. Havevill, 3rd Edition, McGraw Hill, 1971.
7. Theory and problems of Laplace Transforms, Murray R. Spigel, International edition, McGraw Hill, 1986.
8. Matrices and Tensors in Physics, A.W. Joshi, 3rd Edition, Wiley Eastern limited, 1995.

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.

Boltzmann transport equation – Sommerfield's theory of electrical conductivity – Hall Effect (solid). Experimental determination of Hall coefficient.

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

Polar and non polar dielectrics – Dielectric constant – Polarizability: Electronic, Ionic and dipolar – Lorentz fields - Clasiuss Mossati relation – Measurement of dielectric constant: Schering bridge method – Hetrodyne method – Molecular structure and dielectric properties of materials – Piezoelectricity.

Unit – V: Superconductivity

Superconductivity – Occurrence, application and destruction. Meissner effect (detailed study and discussion). London's equation. Penetration depth and coherence length. Elements of BCS theory. Flux quantization. Normal tunnelling and Josephson's effect. High Tc superconductivity. High temperature superconductors and characterizations: $LaBaCuO_4$ and $YBa_2Cu_3O_7$

Text Books and References:

1. Solid State Physics, M.A. Wahab, Narosa Publishing House, 1999.
2. Fundamentals of Solid State, Physics B.S. Saxena, R.C. Gupta and P.N. Saxena, Pragathi Prakashan. Meerut. 1996.
3. Solid State Physics, Adrianus. J. Dekkar, Macmillan India Ltd., 1981.
4. Introduction to Solid State Physics, C. Kittel, Wiley eastern Ltd., 1971.

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

Introduction to electromagnetism - Equation of continuity - Displacement current - Modification of Ampere's law - Characteristics of displacement current - Physical interpretation of Maxwell's postulate.

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 - Fersenel's diffraction by rectangular aperture -Babinet's Principle.

Plasma Physics

Nature and occurance of plasma – Plasma oscillations - Quasineutrality of plasma - plasma behavior in a magnetic field - Plasma as a conducting fluid - Magnetohydrodynamics - magnetic confinement - Pinch effect - Instabilities of plasma - Hydromagnetic waves - Alfven waves.

Text Books and References:

1. Electromagnetic Theory and Electrodynamics, SatyaPrakash, Kedar nath Ram and Co, 1986.
2. Electromagnetics, B.B Laud, Wiley Eastern Company, 2000.
3. Fundamentals of Electromagnetic, Wazed Miah, Tata Mc Graw Hill, 1980.
4. Basic Electromagnetic with Application, Narayana rao, (EEE) Prentice Hall, 1997.
5. Contemporary Optics, Ghatak and Thiyagarajan, Macmillan, 1992.
6. Principles of Optics, M. Born and E. Wolf, Pergamon Press, Oxford, 4^{th} edition, 1970.
7. Introduction to Classical and Modern Optics, Meyer, Ardent, EEE series Prentice Hall, 1990.

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

Intel 8085 microprocessor: Introduction – Pin configuration- Architecture and its operations - Memory interfacing – I/O interfacing. Instruction classification: number of bytes, nature of operations- Assembly language programming: Instruction format.

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

Intel 8086 microprocessor: Introduction – Architecture - Pin configuration- Operating modes: Minimum mode, Maximum mode. Memory addressing: 8-bit data from even and odd address bank, 16-bit data from even and odd address bank. Addressing modes. Interrupts: Hardware interrupts – Software interrupts –Interrupt priorities.

Unit – IV: Introduction to High End Processor

Intel 80286–80386–80486–Pentium.

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:

1. Microprocessor Architecture, Programming and Applications with 8085/8080, Ramesh S. Gaonkar, New Age International 6th edition, 2013.
2. Microprocessors and Interfacing-Programming and Hardware, Douglas V. Hall, Tata McGraw Hill, 1993.
3. Advanced Microprocessors and Interfacing, Badri Ram, Tata McGraw Hill, 2001.

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
8. Characteristics of He-Ne Laser.
9. Diffraction at straight edge using Laser.
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.

SECOND YEAR : THIRD SEMESTER

PHYC 301 - QUANTUM MECHANICS – I

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

Linear Harmonic Oscillator – Solution – Properties of Stationary states – Zero point energy – Three dimensional harmonic oscillator – Spherically symmetric particles – Angular momentum operators – Hydrogen atom wave equation – Separation of variables – Solution of radial and angular equations – Space quantization – Discussion of bound states – Parity. Angular momentum - Eigen functions – Rigid rotator – Application to diatomic molecules – Energy level spacing.

Unit – II: Representation Theory

Schrodinger picture – Heisenberg picture – Interaction picture, energy representation. Identical particles – Physical meaning of identity, symmetric and asymmetric group – Distinguishable of identical particles – Pauli's exclusion principle – Connection with statistical mechanics – Exchange degeneracy.

Operators – Hilbert space – Dirac, Bra and Ket notation – Physical meaning of matrix elements – Harmonic oscillator – Solution using ladder operators and matrix representation.

Unit – III: Approximation Methods: Perturbation

Stationary states – Perturbation theory – Time independent – Non-degenerate cases – First and Second order perturbation – Anharmonic oscillator, degeneracy – Removal of degeneracy– Zeeman effect without electron spin - Stark effect in hydrogen atom – First order perturbation of Helium like atoms- Harmonic Perturbation.

Unit – IV: Approximation Methods: Variation and WKB Approximation

Variation theorem – Ground state of Helium like atom-Hydrogen molecule ion, The Deutron comparison with perturbation method – Electron interaction energy, Vanderwalls interaction's **-** WKB approximation – Asymptotic nature of solution – Validity of WKB approximation – Solution near a turning point – Connection formula – Energy level of a potential well – Bohr – Sommerfield quantization rule – Tunneling through a potential Barrier (qualitative).

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.

Partial wave analysis – Asymptotic behaviour of partial waves – Phase shifts – Scattering amplitude in terms of phase shifts – Differential and total cross section – Optical theorem – Low energy scattering – Resonant and non-resonant scattering – Scattering length and effective range – Physical explanation – The Ramsauer – Townsend effect.

Text Books and References:

1. A Text Book of Quantum Mechanics, P.M Mathews and K. Venkatesan, Tata McGraw Hill publishing co. Ltd, 1975.
2. Quantum Mechanics, Leonard I Schiff, 3rd edition, McGraw Hill book company, 2000.
3. Quantum Mechanics, G.S. Chadda, New age International, 2005
4. Quantum Mechanics, V. Devanathan, Weily Eastern, 2005
5. Quantum Mechanics, V.K Thankappan, 2nd edition, New Age International (P) Ltd., 1999.
6. Advanced Quantum Mechanics, Sathyaprakash, PragathiPrakhasan publishing Ltd., Meerut, 1996.
7. Quantum Mechanics, A.K.Ghatak and S.Loganathan, The Mc Millan and Co,1985
8. Quantum Mechanics, G.Aruldas, Prentice Hall of India Pvt. Ltd.,2002

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

Growth of crystals – Solution growth method, melt method - Bridgeman and czchrolski method – Vapour deposition technique.

Production of thin films : Thermal evaporation – Chemical vapour deposition – Spary pyrolysis – Sputtering – Spin coating method - Thickness measurement : Fizeau interference method and Weight loss method - Electrical and optical properties of thin films.

Unit – II: Defects

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

Solid Solution: Interstitial and substitution solid solutions – Hume – Rothery electron compounds – Long range order theory of Bragg and Williams – Super lattices – Intermediate and interstitial phases – Intermetallic compounds. Elementary ideas of corrosion and oxidation

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

Dislocations: Edge and Screw dislocations – Burgers vector – Plastic deformation – Slip.

Unit – III: Optical Properties and Ferro Electrics

Color centers – Photo conductivity – Electronic transitions in photo conductors – Trap, capture, recombination centres – General mechanism – Luminescence – Excitation and emission – Decay mechanisms – Thallium activated alkali halides – Sulfide phosphorous – Simple discussion on Thermoluminescence and electroluminescence

Ferroelectrics: Ferro electricity – General properties – Dipole theory – Ionic displacements and the behaviours of $BaTiO_3$ – Spontaneous polarization of $BaTiO_3$ – Thermodynamics of Ferro electric transitions – Ferro electric domains.

Unit – IV: Magnetism

Ferromagnetism – Spontaneous magnetisation – Weiss theory – Temperature dependence of spontaneous magnetisation – Weiss molecular field – Nature and origin – Exchange interaction – Ferromagnetic domain – Experimental evidence – Origin of domains – Bloch Wall. Molecular field theory of antiferromagnetism and ferrimagnetism. Explanation for Hysterisis.

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.

Polymers: Polymerization mechanism – Polymer structures – Deformation of polymers – Behaviour of polymers.

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

Text Books and References:

1. Material Science and Engineering, V. Ragavan, Prentice Hall of India, 1995.
2. Fundamentals of Solid State Physics, B.S. Saxena,R.C. Gupta and P.N. Saxena, Pragathi Prakashan, 1996.
3. Soild State Physics, RL. Singhal, Kedar Nath Ram Nath and Co, 2001.
4. Elements of Material Science and Engineering, LH. Van.Vlack, Addison Wesley Publishing Co., 1987.
5. Solid State Physics, RC. M. Kachava, Tata McGraw Hill, 1994.
6. Material Science, M. Arumugam, Anuradha Publications, 2006.

7. Solid State Physics, A.J. Dekker, Mc Millan Publications, 1981.
8. Material Science, G.K. Narula, K.S. Narula, V.K. Gupta, Tata McGraw Hill, 2000.

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

Applications: LCD interfacing – ADC interfacing – Interfacing with temperature sensor LM34 and LM 35. Interfacing of 8051 with stepper Motor – Key board interfacing – DAC interfacing.

Text Books and References:

1. The 8051 Microcontroller and Embedded systems, Muhammad Ali Mazidi and Janice Mazidi. Pearson Education, 2000.
2. The 8051 Microcontroller Architecture, Programming and Applications. Kenneth J. Ayala. Penram International publishing Pvt. Ltd., second edit, 1996.
3. The 8051 Microcontrollers, Architecture, Programming, Interfacing and System Design, Raj Kamal, Pearson Education, 2012.
4. The 8051 Microcontroller and Embedded Systems using Assembly and C, 2nd Edition, Pearson Education, 2007.

PHYP 304 - PRACTICAL – III

(Any Sixteen Experiments)

1. Low field Hysterisis
2. Susceptibility of liquids using Guoy-Balance
3. Susceptibility of liquids by Quinke's method
4. Photo elastic constant
5. Hysterisis loop tracer
6. Cu-Salt (visible) Spectrum
7. Molecular constants-CN Band
8. Channel Spectrum
9. R.F.Oscillator- construction and determination of dielectric constant.
10. Ultrasonic velocity of liquid mixtures- Interferometer
11. Phase diagram of single component-using Potentiometer.
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

SECOND YEAR : FOURTH SEMESTER

PHYC 401 - QUANTUM MECHANICS – II

Objective: To bring exposure to the kinetics of relativistic and non-relativistic concept.

Unit – I: Time Dependent Perturbation

Time dependent perturbation theory – First order perturbation – Density of states – Transition probability per unit time – Fermi's Golden rule – Harmonic perturbation. Semi classical theory of radiation – Absorption and induced emission – Spontaneous emission – Einstein's A and B coefficients – Inter relation – Dipole transition – Selection rules for the single particles – Selection rules for many particles – Photo electric effect – Kramer-Heisenberg dispersion formula – Raman scattering.

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 – Spinars density matrix – Addition of angular momentum – Triangular rule – Coupled and uncoupled representation – CG coefficient for $j_1=j_2= ½$.

Unit – III: Quantum Theory of Valency

Hydrogen ion – Secular equation for energy – Hydrogen molecule – Heitler-London method – Potential energy of the hydrogen molecule – Symmetric and anti symmetric potential – LCAO – MO theory – Hybridisation – Application to methane, benzene and water molecules. Central field approximation – Thomas-Fermi statistical method- Density functional theory – Basic idea of SCF, Hatree and Hatree - Fock method.

Unit – IV: Relativistic Quantum Mechanics

Inadequacy of Schrodinger equation – KG equation – Merits and demerits – application to Hydrogen atom. Dirac's relativistic Hamiltonian – Dirac matrices and their properties – Plane wave solutions – Spin of a Dirac particle. Probability density-Magnetic moment of electron-spin orbit interaction-Radial equation for an electron in a central potential-Hydrogen atom.

Unit – V: Field Quantization

Electromagnetic wave as Harmonic oscillators – Quantization of field oscillators – Photons – Number operator – Creation and annihilation operators of photons – Atom interacting with a quantized radiation – Spontaneous emission – Elements offield quantization for nonrelativistic field – Systems of Bosons fermions – Eigen value spectrum.

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

Text Books and References:

1. Quantum Mechanics, L.I. Schiff, McGraw Hill, 2000.
2. A text book of Quantum Mechanics, P.M Mathews and K. Venkatesan, Tata McGraw Hill publishing company Ltd., 2002.
3. Quantum Chemistry, Eyring Walter and Kimble, McGraw Hill,1968
4. Quatum Mechanics, G.S. Chadda, New Age International,2005
5. Quantum Mechanics, V. Devanathan, Weily Eastern, 2005.
6. Quantum Mechanics, V.K. Thankappan, II edition, New Age International (P) Ltd., 1996.
7. Advanced Quantum Mechanics, Sathyaprakash, Pragathiprakash publishing Ltd,1996.
8. Fundamentals of Quantum Mechanics, Y.R. Weghmare, Wheeler publishing, Chennai, 1974.
9. Relativistic Quantum Mechanics, J.D. Bjorken and S.D. Drell, McGraw Hill, 1964.
10. Quantum Mechanics, G.Aruldhas, Prentice Hall of India, 2002.

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.

Magnetic dipole moment - Electric quadrupole moment - Measurement of the charged radius using electron scattering experiment. Double focussing mass spectrograph - Cyclotron mass spectrograph.

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.

Neutron physics: discovery of neutrons- neutron sources - Fundamental properties of neutron - Classification of neutrons- Detection of neutrons - Neutron diffusion- Thermal neutron diffusion - Diffusion of fast neutrons and Fermi age equation.

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

Classification of elementay particles - Fundamental particle interactions - Conservation laws - CP and CPT invariance - CP violation in neutral K-decay, hyper nuclei-strangeness and associated production - Gell-Mann-Nishijima formula - Gellmann-okubo mass formula.

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:

1. Elements of Nuclear Physics, M.L. Pandiya and P.R.S Yadav, Kedar Nath, Ram Nath, 1993.
2. Basic Nuclear Physics, S. Srivastava, Pragathi Prakashan, 1998.
3. Nuclear Physics, R.R. Roy and B.P. Nigam, Wiley, Estern Ltd., 1993.
4. Nuclear Physics, S.N. Ghoshal, S. Chand and Co., 2006.
5. Nuclear Physics, D.C. Tayal, Himalaya Publishing House, 1995.
6. Theoretical Nuclear Physics, John. M. Blatt and Victor V. Weisskopf, John Wiley and Sons, 1952.
7. Nuclear Physics, Irving Kaplan, Narosa Publishing House, 1996.
8. Basic Nuclear Physics and Cosmic Rays, B.N. Srivatsava, Pragathi Prakashan, 1992.

PHYC 403 - SPECTROSCOPY

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_2V and C_3V 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_2O 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 – Hyper fine 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.

Principle of Mossbauer Effect –Recoilless emission and absorption – Mossbauer spectrometer – schematic (basic) arrangement – principle of detecting Mossbauer absorption (nuclear volume effect) signal – chemical isomer shift – Theories and interpretation. Electric quadrupole interactions – magnetic interactions – Applications of Mossbauer with special reference to molecular structure, geometrical isomerism, oxidation states and magnetic ordering – geological and biological applications.

Unit-V: Fluorescence and Phosphorescence Spectroscopy.

Origin of Fluorescence and Phosphorescence – resonance fluorescence and normal fluorescence – selection rules – Shpolskii effect – Phosphorescence – triplet states – intensity – delayed fluorescence – spectrofluorimeter design – analytical applications of fluorescence and phosphorescence.

Text Books and References:

1. G.M. Barrow – Introduction to Molecular Spectroscopy, McGraw Hill,1962.
2. C.N. Banwell – Fundamentals of Molecular Spectroscopy- Tata McGraw Hill, 1962.
3. B.P. Straughan and Walker – Spectroscopy – Chapman & Hall, 1976.
4. S.L. Gupta, V. Kumar and R.C. Sharma – Elements of Spectroscopy – Pragathi and Prakashan Publishing Company, Meerut, 1974.
5. Gurdeep Chatwal and Sham Anand – Spectroscopy (Atomic and Molecular) – Himalaya Publishing House**,** 2003.
6. J.E. Wertz & J.R. Boulton – Electron spin resonance – Elementary theory and Practical applications – McGraw Hill – 1972.

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

Introduction – History of nanotechnology - Classification of nanomaterials: Definition of – Zero, one and two dimension nano structures – Examples - Classification of synthesis methods. Surface energy – Chemical potential as a function of surface curvature – Electrostatic stabilization - Steric stabilization – DLVO theory.

Unit – II: Special Nanomaterials

Carbon Fullerenes and Nanotubes: Carbon fullerenes, Fullerene derived crystals, Carbon nanotubes. Micro and Mesoporous Materials: Ordered mesoporous structures, Random mesoporous structures, crystalline microporous materials. Core-shell structures: Metal-oxide structures, Metal-polymer structures, Oxide-polymer structures. Organic-Inorganic Hybrids. Intercalation Compounds – Nanocomposites.

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

Synthesis of nano materials: Physical vapour deposition - Chemical vapour deposition plasma arching - Sol gel - Ball milling technique - Reverse miceller technique - Electro deposition. Synthesis of Semiconductors: Nanostructures fabrication by physical techniques – Nano lithography – Nanomanipulator.

Unit – V: Characterization and Applications

Structural Characterization: X-Ray diffraction – Scanning tunneling Microscopy – Transmission Electron Microscopy – Chemical Characterization: Optical spectroscopy.

Applications: Molecular electronics and Nano electronics, Nano electromechanical systems- Colorants and pigments –DNA chips – DNA array devices – Drug delivery systems.

Text Books and References:

1. Nanoscale Materials in Chemistry, Kenneth F. Klablunde, John wiley and sons, Inc., 2001.
2. The Essentials, Pradeep T, Nano: Tata MC Graw-Hill publishing company limited, 2007.
3. Nanobiotechnology: Concepts, Applications and Perspectives, Christof M. Niemeyer, Chad A. Mirkin, 2004.
4. Nanotechnology, Wilson M, K Kannangara, G. Smilt, M. Simmons and B. Boguse-Overseas Press, 2005
5. Nanomedicine, Freitas R A, Landes., TX publication, 1996.
6. Nano Materials, Viswanathan B, Narosa publishing house, 2010.

PHYP 405 - PRACTICAL – IV

(Any Sixteen experiments)

1. Spectrophotometer
2. Co-effeicient of linear expansion-Interference Method.
3. R.F. Oscillator- Dipolemoment 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.
9. Cu-Salt spectrum ultra violet region.
10. Optical rotation of quartz.
11. G.M. Counter -Absorption co-efficient of a foil.
12. F.P. Etalon.
13. Dielectric of Solidsm
14. Particle size analyzer using Laser.
15. Stark Effect.
16. Micro hardness of a Crystal.
17. 8051 Micro controller - Setting bits and Masking bits in an 8-bit number.
18. Microcontroller 8051 - Generate a delay.
19. Microcontroller 8051 - DAC interfacing.
20. Microcontroller 8051 – Display and Rolling of messages.

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.

LVDT: Principle –Working –Measurement of displacement.

Electrical Strain Gauge: Principle-Theory-Types-Working -Measurement of Force (or) Pressure.

Capacitive Transducers: Principle-Types-Working-Measurement of linear and angular displacement.

Thermistor: Principle-Working-Measurement of temperature.

Piezo electric transducers: Principle, theory and working of piezo electric crystals.

Unit – II: Digital Instrumentation

Principle, block diagram and working of: Digital Multimeter, Digital Frequency counter, Digital P_H meter, Digital conductivity meter, Digital storage Oscilloscope and Q-meter.

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

Orgin of Bio–potentials: Measurements- Resting and action potentials-Characteristics of resting potential-Bio electric potentials-Types of bioelectric signal and their characteristics.

Components of the Bio-medical instrument system-Electrodes: Equivalent circuit-Theory -Types.

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

Unit – V: Medical Imaging Instrumentation

Magnetic Resonance Imaging: Principle-Magnetic resonance phenomena-Magnetic resonance imaging-Imaging process-Instrumentation.

Ultrasonic Imaging System: Principle-Construction of an ultrasonic transducer-Ultrasonic propagation through tissues-Display-A mode- B mode- M mode-TM mode-Doppler mode- Recording devices.

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

Text Books and References:

1. Electrical and Electronics Measurement and Instrumentation, A.K.Sawhney, Dhanpath Rai and Co., Pvt., Ltd., 2000.
2. Electronic measurements and Instrumentation, Dr.Rajendra Prasad, Khanna Publishers, 2002
3. Instrumental methods of analysis, Willard.D. Merrit et.al.,CBS Publishers, 2004.
4. Instrumental methods of analysis, Gurdeep Chatwal and Sham Anand, Himalaya Publishers, 2003.
5. Biomedical Instrumentation, M.Arumugam, Anuradha Publishers, 2001.
6. Hand Book of Biomedical Instrumentation, R.S.Khandpur, TMH, 2004.
7. Instrumentation, B.C.Nakra and K.K.Chawdry, Measurement and Analysis, TMH, 2004.
8. Modern Electronic Instrumentation and Measurement Techniques, Albert D.Helfrock and William D Cooper, Printice Hall of India, 2000.
9. Instrumentation, V.Ramasamy, Swami Publications, 2005.
10. Bio Medical Electronics and Instrumentation, S.K.Venkata Ram, Galgotia Publications Pvt. Ltd., 2001.

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

Light microscope- Resolving Power- Phase contrast microscope- Detection of small differences in refractive indices- Interference microscope-, Dark field microscope-Polarization microscope- Fluorescence microscope- Cytophotometry methods-Flowcytometry & cell sorting- Electron microscopy- specimen preparation- Scanning Electron Microscopy (SEM)- Transmission Electron Microscopy (TEM)-Applications.

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.

Proteins structure: Amino acids and the primary structures of proteins – Secondary – Tertiary - Quaternary structure and virus structure.

Unit-IV: Seperation Techniques

Centrifugation**:** Principle of centrifugation –Analytical ultracentrifugation – Differential centrifugation – Density gradient centrifugation.

Chromatography**:** Principles of chromatography– Paper chromatography – Thin layer chromatography (TLC) – Gas liquid chromatography (GLC) – High performance liquid chromatography (HPLC).

Electrophoresis: Principles – Factors affecting the migration of substances – Supporting media in electrophoresis – Gel electrophoresis – Polyacrylamide gel electrophoresis (PAGE) – Sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE).

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 disperson (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-

centrosymmetric crystals- General remarks on Protein-Structure determination from X-ray diffraction data-Neutron diffraction-, Electron diffraction-, Synchrotron diffraction, Application in Biomolecular structural studies.

Text Books and References:

1. The Cell: A Molecular Approach, Geoffrey M.Cooper, ASM Press, 2013.
2. Biophysics, Vasantha Pattabhi, N. Gautham, Narosa Publishing, 2009.
3. Biophysics P.S. Mishra, VK Enterprises, 2010.
4. Biophysics, M.A. Subramanian, MJP Publishers, 2005.
5. Bioinstrumentation, L.Veerakumari, MJP Publishers, 2006.
6. Fundamentals of Biochemistry, A.C. Deb, New central book agency, 2011.

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

Principle of Newtonian Mechanics – particle mechanics – conservation laws of linear momentum, Angular momentum and energy of a particle and body – Constraints and classification with examples – particle motion under a constant force – Motion of a system with variable mass.

Unit – II

Principle of virtual work – D'Alembert's principle – generalized coordinates – Lagrange equations – Cyclic or ignorable coordinates – remarks about the Lagrangian – Generalized moments and energy – Hamilton's principle – Hamilton's equations of motion.

Unit – III

Motion of a rigid body – the inertia tensor – Euler's equation of motion – Euler's angles – motion of a symmetric top – Poisson brackets and their properties – conservation theorems in Poisson brackets – small oscillations – normal modes – free vibrations of linear triatomic molecules – Harmonic oscillator – as an example of Hamilton-Jacobi method.

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:

1. R.G.Takwale and P.S.Purani, Introduction to classical mechanics - Tata Macgraw Hill Publishing co Ltd., New Delhi.

2. B.D.Gupta and Sathyaprakash.-Classical Mecanics-Kedaernath Ramnath and CO .
3. Sathyaprakash and J.P.Agarwal- Statistical Mechanics- Kedar Nath Ram nath and Co.Publishers, MEERUT. 2003.
4. M.C Guptha -Statistical Thermo Dynamics -Weiley Eastern Limeted,New Delhi.
5. Herbert Gold Stein, - Classical Mechanics – Narosa Publishing House, Chennai .
6. V.B.Bhatia., - Classical Mechanics, Narosa Publishing House, Chennai – 6 ,1997
7. B.K.Agarwal and Melvin Eisner, - Statistical Mechanics- New age international (p) Ltd. Chennai, 1994.
8. S.C.Garg, R.M.Bansal and C.K.Ghosh , - Thermal Physics. Tata McGrew Hill Publishing co Ltd. Delhi,1993.

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

Rotation of the Earth - Gravitational attraction, Gravitational Theory, Measurements of Gravity, Gravity meters - Principles and method of measuring gravity - Gravity anomalies-Local and regional variations.

Unit – 3: Thermal history of earth

Thermal history of the Earth. Temperature in the Primitive Earth and the Earth's surface and interior. Thermal conductivity. Generation of heat in the Earth. Heat flow measurements, methods and results.

Unit – 4: Elastic properties

Elastic constants and Elastic process in the earth. Earth's free rotation. Latitude variation. Tides of the Solid earth. Numerical values of Love's numbers. Rigidity of the Earth. Bulk modules in the earth. Poisson's ratio in the Earth, Young's modulus and Lame's constant.

Unit – 5: Geomagnetism and Palaeomagnetism

Geomagnetism and palaeomagnetism-Earth's magnetic field. Origin-Theory of earth's magnetic field. Magneto hydrodymics of the Earth. Magnetic reversals. Polar wandering. Tectonic movements and its relation to palaeomagnetism - Measurement of magnetic properties of rocks.

Text Books and Reference:

1. Physics of the Earth and Planets, A.H.Cook , Macmillan, 1973.
2. Physics of the Earth's Interior, Gutenberg, International Geophysics series, Vol.1 Academic press, 1959.
3. Physics and Geology, J.A.Jacobs, R.D.Russel and J.T.Wilson,1974.
4. International student edition. P.J.Wyllie, The Dynamic Earth, John Wiley and sons, 1971.
5. Applied Goephysics, A.S.Eve and Keys,D.A, Cambridge University, 1954.
6. The Solid Earth: An Introduction to Global Geophysics, C.M.R .Fowler, Cambridge University press, 1990.
7. Geomagnetic reversals and Plate tectonics, Alan Cox, Freeman and company, 1973.

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-Ultrasonic 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

Blood Pressure Measurement-Introduction-Direct Measurement using Catheters-Advance of Direct Method-Indirect Method-Oscillometric measurement method.

Electromagnetic Blood Flow Meters-Ultrasonic Blood Flow Meter-transit time method-Doppler effect based ultrasonic blood flow meter-laser Doppler Blood Flow Meter-NMR Blood Flow Meter

UNIT – V: Laser in Medicine

Introduction- Characteristics of laser light- Generation of laser- Components of laser-Types of laser-Nd-YAG laser-Helium-Neon laser - CO_2 laser- Semiconductor laser-Applications of laser in Medical field.

Text Books and References:

1. Bio Medical Instrumentation, T.Rajalakshmi, First Edition, Sams Publishers, 2008.
2. Biomedical Instrumentation, M.Arumugam, Fourth reprint, Anuradha Agencies, 2000.
3. Hand book of Biomedical Instrumentation, R.S. Khandpur, Tata McGraw Hill, 2007.

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

Solar Energy - Thermal application and solar radiation – Energy alternatives – Devices for thermal collection and storage – Thermal applications – Water heating – Space heating – Power generation – Instruments for measuring solar radiation and sun shine.

UNIT – III: Thermal Energy Storage

General characteristics - Definitions - Methods of classifications - Thermal energy storage - Sensible heat storage - Liquids - Solids – Latent heat storage - Thermal chemical 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

Wind energy - Recent developments – Hydel energy - Energy from waves and tides – Thermal energy – Energy from biomass – Bio diesel – Physical and chemical properties of Bio diesel.

Text Books and References :

1. Solar energy (Second edition), P. Sukhatme, Tata McGraw-Hill, 2008.
2. Renewable energy sources and emerging Technologies, D.P. Kothari, K.C. Singal and Rakesh Ranjan, Prentice Hall of India, 2008.
3. Renewable Energy sources and their Environmental Impact, S.A. Abbasi and Nasema Abbasi PHI Learning Pvt. Ltd., 2008.

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: Seperation Technique

Chromatography- Column Chromatography, Thin layer Chromatography, Paper Chromatography, Adsorption Chromatography, Partition Chromatography, Gas liquid Chromatography, High performance liquid Chromatography.

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.

Introduction- Characteristics of laser light- Generation of laser- Components of laser- Types of laser-Nd-YAG laser-Helium Neon laser - CO_2 laser- Applications of laser in Medical field.

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

Elecromagnetic radiation- Beer-Lambert's law- Calorimeter- Spectrometer- Single and Double beam Spectophotometer- 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