SCHOOL OF PHYSICAL SCIENCES

The School of Physical Sciences comprises the Department of Crystallography and Biophysics, the Department of Nuclear Physics, the Department of Theoretical Physics and the Department of Central Instrumentation and Services.

The Department of Crystallography and biophysics was founded in 1952 with Prof. G.N. Ramachandran, F.R.S., as the Head. His genius guided the Department in its early years and lead to several pioneering centre in the country and is the home of the Triple Helical Structure of Collagen and the famous Ramachandran plot for the protein structure. In keeping with the great tradition, significant contributions to contemporary research topics continue to be made by the present faculty. The research theme of the faculty continues to be Structural Biology (i) to elucidate the structure – function relationship of biological systems with special emphasis on biopolymers; and (ii) the development of methodologies for structural characterization of biomolecules. Faculty members are involved in research on structure and function of biological molecules including proteins, peptides, nucleic acids, drug molecules etc. Methods used include theoretical and computational studies, computer modeling, X-ray crystallography, NMR spectroscopy and other biophysical techniques. Research is also carried out on the development of crystallographic structure solution methods. Since its inception the department has published over 1000 research papers and 22 books and volumes. The Department has hosted about 10 International conferences and about 40 at the National Level. A large number of distinguished scientists from India and abroad including more than 30 Nobel Laureates have visited the Department Right from the beginning the University Grants Commission has been supporting the research activities of the Department generously through grants under CAS, SAP and COSIST programmes. Recently the Department of Science and Technology has recognized this Department for assistance under FIST Programme (Level II)

The Department conducts a two year M.Sc. (Biophysics) course besides Ph.D. programme. The sophisticated equipments of the department include single crystal X-ray Diffractometer, IR and UV visible spectrophotometers, ultracentrifuge, several SGI workstations and a large number of PC's. A modern biochemical laboratory with state-of-the-art equipment is also available.

The Department of Theoretical Physics and the Department of Nuclear Physics had jointly received UGC funding for their teaching and research activities under COSIST programs for ten years and the Department of Nuclear Physics had also been funded under UGC-SAP programs for fifteen years for augmentation of research facilities. The M. Sc. program in Physics is offered jointly by the faculty of the Department of Theoretical Physics and the Department of Nuclear Physics. The M. Sc. program in Electronics Science is offered jointly by the faculty of these two departments and the Department of Central Instrumentation and Services Laboratory The above teaching programs and the research programs of the Departments of Nuclear Physics and Theoretical Physics have been sanctioned generous funding under the FIST program of DST for a period of five years from 2004. The independent teaching and research profiles of these departments are as follows.

Department of Theoretical Physics

The Department of Theoretical Physics offers also independent M. Phil. and Ph.D. Programmes. The teaching / research activities of the department focus on Quantum Mechanics, Semiclassical Methods and Path Integrals, Non-linear Dynamics, Atomic Structure, Quantum Groups, Geophysics, etc. The facilities of the Department include a Computer centre for carrying out computing activities. The Department offers consultancy in the areas of Models for Weather, Ecological Balance, etc.

Department of Nuclear Physics

The Department of Nuclear Physics offers also independent M. Phil. and Ph.D. programmes. The research activities of the department concentrate broadly on Experimental Solid State Physics and Materials Science. The various fields in which research programmes are currently being pursued are: 1. Nanostructured materials for a) dielectric b) dilute magnetic semiconducting c) environmental d) optical e) semiconducting and f) magnetic applications, 2. Accelerator-based material modifications, 3. Semiconducting / Scintillating Single Crystals, 4. Dye-sensitised Solar Cells, 5. Layered Structures and 6. Crystal Structure Determination. Research expertise in Mathematical approaches to Quark-Gluon Plasma, Signal Processing and in Experimental Techniques for Nanomaterial Synthesis, Mössbauer Spectroscopy, Positron Annihilation Spectroscopy, X-ray Diffraction, Electrodeposition, High-pressure Synthesis, Electron Momentum Distribution, Thermal Analysis and Ion-implantation is available in the faculty of the department The department enjoys the facilities of a separate Library and a Computer Laboratory with a DEC Alpha Station minicomputer and several PCs. The Department has the following experimental facilities for material preparation: Box and Muffle Furnaces, Chemical Laboratory, Crystal Grinder/Polisher, High-pressure anvil, Hydraulic Press, Induction Furnace, Planetary Ball Mill, Pulsed-electrodeposition set-up, and UHV Chamber for Nanomaterial Synthesis. The following material characterization facilities are also available: 1D Positron Angular Correlation Setup, 2D- Positron Angular Correlation Setup, Positron Lifetime Spectrometer, Positron Doppler Broadening Setup, A.C. Susceptometer, Four-probe Resistivity Setup, Impedance Analyser, Metallurgical Optical Microscope with Vicker's Indenter, Mössbauer Spectrophotometer, Thermal Analysis Facility (DSC, DTA & TGA), Vibrating Sample Magnetometer

and X-ray Powder Diffractometer. In addition, the department houses a Modern Workshop with Lathe, Drilling, Milling and Grinding facilities. The research output of the department has lead to about 400 publications in International Journals. The Department has the expertise to offer consultancy in the following: Development and Characterisation of Magnetic Materials and the Fabrication of Magnets, Development of Varistors for High Voltage Applications, Nanoparticle (ultrafine) Technology, Structural Characterisation using X-ray Diffraction for Chemical, Pharmaceutical and Engineering Industries, Computer Interfacing, Design of electronic gadgets, Computer Hardware and Software and Machine Jobs

Department of Central Instrumentation and Service Laboratory (University Scientific Instrumentation Centre)

University Grants Commission has established Centres for providing Instrumentation and Engineering service facilities to Scientific Research as well as for promoting R & D in Instrumentation Technology in several Universities in the Country since 1976. One such Centre was established in 1976 in Madras University as the Central Instrumentation and Service Laboratory (CISL) and later upgraded as the University Science Instrumentation Centre (USIC) in 1980. This Centre maintains sophisticated Scientific Instruments and has been involved in conducting training programs to the faculty as well as the technical staff as per UGC guidelines in addition to the regular R & D work. To develop research aptitude in Instrumentation, an M. Phil Course on Scientific Instrumentation is being conducted since 1984 and also Ph. D programmes are offered since 1977 in various aspects of Instrumentation. This Centre has carried out a number of research projects. The several University Departments as well as Colleges have made use of this Centre for their research work. The M. Sc., (Electronics Science) course is conducted jointly by this department and the Departments of Nuclear Physics & Theoretical Physics.

The Centre has an Electronic testing wing for the testing and servicing of all Electronic/Scientific Instruments and has facility and expertise for the development of advanced circuit designs for various instrumentation applications. In addition to this, a well-equipped Instrument fabrication workshop is available. Liquid Nitrogen Plant is available in this Centre, which has been supplying liquid nitrogen for conducting the low temperature studies and specimen preservation.

The Department has done Research work, in collaboration with several agencies such as the C.L.R.I., C.S.I.O, C.E.E.R.I., and local Hospitals, in several areas of Instrumentation including Scientific Instrumentation, Instrumentation for Tannery Effluent treatment and medical diagnostics. As evidence of research contribution, several research papers as well as technical articles have been published in refereed journals on various aspects of instrumentation.

P. R. Subramanian, Ph. D. **- Chairperson of the School**

Faculty

Crytallography and Biophysics

G. Shanmugam, Ph.D	-Professor and Head
K.S. Girirajan, Ph.D.	-Professor
S.S. Rajan, Ph.D.	-Professor
D. Velmurugan, Ph.D.	-Professor
M.N. Ponnuswamy, Ph.D.	-Professor
N. Gautham, Ph.D.	-Professor
P. Karthe	-Reader

Theoretical Physics

M. Seetharaman, Ph. D.	- Professor and Head
S.S. Vasan, Ph. D.	- Professor
M. S. Sriram, Ph. D.	- Professor
K. Raghunathan, Ph. D.	- Reader
Ranabir Chakrabarti, Ph. D.	- Reader
A. S. Vytheeswaran, Ph.D	- Lecturer

Nuclear Physics

P. R. Subramanian, Ph. D.	- Professor and Head
A. Narayanasamy, Ph. D.	- Professor
S. Ramasamy, Ph. D.	- Professor
V. Ravichandran, Ph. D.	- Professor
A. Stephen, Ph.D.	- Lecturer
K. Ravichandran, M.Phil.	- Lecturer

C. Venkateswaran, Ph.D. - Lecturer
K. Sivaji, Ph.D. - Lecturer

Central Instrumentation and Services Laboratory

N. Gautham, M. Sc., Ph. D. - Professor and Head - in – Charge
S. Ananthi, B.E., M.Tech., Ph. D. - Lecturer
D. Nedumaran, M. Sc., M. Phil., - Lecturer
B. Ed., Ph. D

M.Sc. BIOPHYSICS..

Subject Code	Course Title	Core/ Elective	Credits *				Course Faculty
			L	T	P	C	
FIRST SEMESTER							
PHY C001	Elementary Crystallography	**C**	2	1	0	3	PK
PHY C002	Principles of Macromolecular Structure & Function	**C**	4	0	0	4	NG/PK
PHY C003	Mathematical Physics	**C**	4	0	0	4	
PHY E001	Computational Biology	**E**	2	1	0	3	NG
PHY E002	Object Oriented Languages	**E**	2	1	0	3	Guest Faculty
PHY E003	Fundamentals of Molecular Spectroscopy (offered for other Departments only)	**E**	2	1	0	3	GS
	SECOND SEMESTER						
PHY C004	Methods of X – Ray Crystal Structure Determination	**C**	3	1	0	4	SSR
PHY C005	Principles and Applications of Spectroscopy to Biomolecules	**C**	3	1	0	4	GS/KSG
PHY C006	Physical Studies of Macro – - molecules in Solution	**C**	3	1	0	4	DV
PHY C007	Molecular Biology of Gene	**C**	4	0	0	4	ND (Biochem)
PHY E004	Algorithms and Data Bases in Bioinformatics	**E**	2	1	0	3	NG
PHY E005	Basic Crystallography (offered for other Departments only)	**E**	2	1	0	3	MNP
	THIRD SEMESTER						
PHY C008	Numerical Methods	**C**	2	1	0	3	KSG
PHY C009	Seminars in Biophysics	**C**	0	3	0	3	GS/SSR/NG
PHY C010	Basic Statistics	**C**	2	1	0	3	DV
PHY C011	Macromolecular Crystallography	**C**	2	1	0	3	SSR/NG
PHY C012	Crystallography Laboratory	**C**	0	0	3	3	MNP
PHY E006	Biophysics of the Immune System	**E**	2	1	0	3	Guest Faculty
PHY E007	Theory and Practice of Direct Methods of Solving Structures	**E**	2	1	0	3	DV
	FOURTH SEMESTER						
PHY C013	Project Work	**C**	0	0	6	6	All Faculty
PHY C014	Membrane Biophysics & Neuro Biophysics	**C**	2	1	0	3	MNP
PHY C015	Biophysics Laboratory	**C**	0	0	3	3	SSR

GS: Prof. G. Shanmugam KSG: Prof. K.S. Girirajan, SSR: Prof. S. S. Rajan, DV: Prof. D. Velmurugan, NG: Prof. N. Gautham, MNP: Prof. M.N.Ponnuswamy, PK : Dr. P.Karthe, Biochem : ND (Biochem) Prof. S.Niranjali Devaraj and TP/ NP: Theoretical Physics / Nuclear Physics Departments.

PHY C001	Elementary Crystallography	C	2	1	0	3	PK

Crystal systems and space groups, X-ray scattering, techniques of X-ray generation, recording of diffraction patterns, Symmetry deduction, absolute configuration, powder & fibre diffraction – Basics of electron and neutron diffraction.

Elementary Crystallography : External features and symmetry – unit cell and Miller indices –crystal systems – Bravais lattices – point groups and space groups – X-ray diffraction – Laue equations – Bragg's law – reciprocal lattice and its application to geometrical Crystallography.
X-ray scattering : Atomic scattering factor – diffraction by a space lattice – structure factor equation – electron density and Fourier series – Fourier Transform and crystal diffraction – diffraction by real crystals – Lorentz and polarization factor – primary and secondary extinctions.
Experimental methods : Generation, detection and properties of X-rays – filters – monochromators – absorption coefficients – choice of radiation, synchrotron radiation.
Outlines of Powder, Laue, Weissenberg and precession methods - interpretation of powder photograph – ASTM index.
Intensity estimation and deduction of structure factor amplitudes – Wilson plot – scale and temperature factors – symmetry deduction and determination of space groups – test for centrosymmetry – use of intensity statistics in space group determination.

Anomalous scattering and violation of Friedel's law – absolute configuration.

Fibre Diffraction : Theory of diffraction by helical structures and application to alpha-helix and DNA.
Elements of electron and neutron diffraction : principles of neutron scattering - neutron scattering lengths - applications of neutron scattering techniques in crystal structure analysis - comparison of X -ray and neutron scattering.

PHY C002	Principles of Macromolecular Structure & Function	C	4	0	0	4	NG/PK

Stereochemistry, conformational analysis, proteins structure, protein folding, nucleic acid structure, polysaccharide structure, macromolecular assembly.
Stereochemistry and concepts of conformation : Asymmetric carbon atom - optical, geometric stereoisomerism - chirality - Fischer convention - L and D residues - torsion angle - hindered rotation.
Conformational analysis : van der Waal's radii or effective nonbonded radii of atoms - contact distance criteria - Noncovalent forces determining biopolymer structure – dispersion forces – electrostatic interactions – van der Waal's interactions - hydrogen bonds - hydrophobic interactions - distortional energies - description of various interactions by potential functions - elementary ideas of minimization of conformational energy and molecular dynamics.
Principles of protein structure : Structural implications **-** Concept of rigid planar peptide unit - *cis* and *trans* configuration – conformation of a pair of linked peptide units - torsion angles phi and psi - steric hindrance - hardsphere approximation - allowed and disallowed conformations - Ramachandran Diagram - specific effects of proline and glyline - conformationally constrained amino acids and their importance.
Levels of organization of polypeptide chains : primary, secondary, tertiary and quaternary structures - types of secondary structures - alpha helix, beta sheet, reverse turns – Super secondary structures – alpha, beta and alpha / beta classification of proteins.
Structure of fibrous proteins : Structure of collagen - structure of silk and wool , structure muscle protein and mechanism of muscle contraction.
Structure and function of globular proteins : Structure and action of myoglobin, hemoglobin, lysozyme, chymotrypsin, pepsin, dehydrogenases - enzyme - substrate interactions.
Protein folding : Anfinsen's principle - Levinthal paradox – Semi empirical Methods of protein structure prediction - Molten globular states – conformational intermediates – chaperones and their function .
Principles of nucleic acid structure : Conformations of nucleosides and nucleotides- Watson and Crick's base-pairings and their implications. Non Watson and Crick pairing schemes - base stacking interactions - DNA polymorphism - structure of ADNA, BDNA and ZDNA - helical transitions. Non-uniform helical DNA Structure.
Unusual DNA structures - hairpins, bulges, cruciform, triplexes, tetraplexes.
Structure of RNA and RNA - DNA hybrid duplexes - Structure of tRNA - Structure of Hammer head ribozymes. Elementary ideas of secondary and tertiary structures of large RNA's.
Principles of polysaccharide structure : Stereoisomerism of hexapyranose sugars - conformation of mono and disaccharides - structures of maltose, cellobiose and laminaribiose and their polymers - bacterial cell wall polysaccharides.
Structure of macromolecular assembly : Principles of packing of protein subunits in rod and spherical viruses - structure of chromatin – Elementary ideas of the Structure of 50s and 30s ribosomal particles.

PHY C003	Mathematical Physics	C	4	0	0	4	NG/PK

PHY E001	Computational Biology	E	2	1	0	3	NG

Strings, Graphs and Algorithms ; Probability Theory - Molecular Simulation and Dynamics - interaction and metabolic networks in cells

Strings, graphs and algorithms

General concept of a string – DNA and protein sequences as strings – string operations – prefixes and suffixes – definition of graphs – classification of graphs – algorithms – definitions – P, NP, NP-hard and NP-complete algorithms

Probability theory

Introduction – simple ideas about distributions – discrete distributions (Bernoulli, Binomial, Uniform, Geometric, and Poisson) – continuous distributions (Uniform, Normal, Exponential, Gamma and Beta) – Statistical inference – Introduction to classical and Bayesian inference

Algorithms on strings

Sequence comparison and database searching – global, local and semiglobal comparison – DNA fragment assembly – the ideal case and complications – phylogenetic tree construction – parsimony – RNA secondary structure prediction

Molecular simulation and dynamics

Basic molecular dynamics – equations of motion – potential functions – integration computations – Initial state – boundary conditions – equilibration – dynamics protocols – trajectories – analyses of results – AMBER, CHARMm, - simple applications to proteins and nucleic acids

Miscellaneous topics

Micro arrays and analyses – DNA computing – Hamiltonian path problem – systems biology – interaction and metabolic networks in cells – whole cell simulations – E-cell and V-cell.

PHY E002	Object Oriented Languages	E	2	1	0	3	GF

Characteristic of Object Oriented Languages - C $^{++}$ Basics - loops and decisions - inheritance - Files and Streams - Java Overview - Multithreaded programming - Networking - event handling - Java Beans -Oracle Fundamentals - Java in Oracle

Characteristic of object oriented languages – C ++ programming basics – loops and Decisions – Structures – functions.

Objects and classes – arrays – operator overloading – Inheritance – pointers – Virtual and tuned functions

Files and streams – Turbo C++ class library.

Genesis of Java – overview – Data types, variables and analysis – Operators – Control statements – Methods & classes – Inheritance- Exception handling multi-threaded programming – I/o, Applets and string handling – Networking – Event handling

Java Beans – Swing – Servlets – Migrating from C++ to Java.

Oracle fundamentals – Queries SQL functions OOP concepts in oracle – Java in oracle.

PHY E003	Fundamentals of Molecular Spectroscopy	E	2	1	0	3	GS

Electromagnetic Spectrum - Microwave, IR and Raman Spectroscopy - Structure determination of simple molecules

Introduction: Characterization of electromagnetic radiation – quantization of energy, Regions of the electromagnetic spectrum – Basic elements of practical spectroscopy.

Microwave Spectroscopy: The pure rotation of molecules - classification of rotors – rotational spectra of diatomic and simple polyatomic molecules as rigid and non- rigid rotors- Techniques and instrumentaion.

Infrared Spectroscopy: The vibrating diatomic molecule – Diatomic vibrating – rotator – Rotation - vibration spectrum of diatomic molecules – Breakdown of Born – Oppenheimer approximation – Interaction of rotation and vibration – vibrations of polyatomic molecules – Influence of rotation on the spectra of polyatomic molecules – Techniques and Instrumentation. Principles of Fourier Transform Infrared Spectroscopy.

Raman Spectroscopy: Introduction - Polarization of light and Raman effect- pure rotational Raman spectrum – vibrational Raman spectrum –. Techniques and Instrumentation. Principles of Laser Raman Spectroscopy.

Structure determination of simple molecules from Raman and infrared spectroscopy.

PHY C004	Methods of X – Ray Crystal Structure Determination	C	3	1	0	4	SSR

Methods of structure determination and analysis, phase problem, Patterson and direct methods, refinement, interpretation of results and analysis

Methods of structure analysis : Phase problem in crystallography - methods of its solution - electron density function, weighting function - convolution theorem.

Patterson Methods : Patterson function and its interpretation - heavy atom method - Patterson search - Patterson methods - techniques - rotation search - translation search. **Direct methods :** Unitary and normalized structure factors - Harker-Kasper inequalities - Sayre's relations - general phase and probability relations - structure invariants and semi-invariants - symbolic addition methods - tangent formula - multisolution methods - maximum determinant method - maximum entropy methods.

Refinement : Fourier refinement - least-squares techniques of refinement .

Interpretation of the results : Bond lengths - bond angles- torsion angles - conformation - accuracy and reliability of the results, thermal motion analysis - Interpretation of results - Crystallographic information file - data bases.

PHY C005	Principles and Applications of Spectroscopy to Biomolecules	C	3	1	0	4	KSG/GS

Infrared, Raman, UV spectroscopy, ORD & CD, NMR spectroscopy, fluorescence spectroscopy, confocal microscopy, simple applications.

Infrared spectroscopy : General principles of spectroscopy - origins of rotational and vibrational spectra - anharmonic oscillator - molecular symmetry - overtone and combination bands - experimental aspects and methods - optical density - investigation of molecular structure with special reference to deuterium exchange, hydrogen bonding - dichroism and crystallinity measurements - applications to polypeptides and proteins - chemical bonding of metal ions to proteins - applications to nucleic acids and polysaccharides, principles of FTIR spectroscopy - advantages.

Raman spectroscopy : Principles - experimental aspects - advantages of Raman spectroscopy - Laser as Raman source - advantages - Raman spectra of amino acids - application to proteins and nucleic acids - Laser Raman spectroscopy.

Absorption spectroscopy : Principles - experimental aspects of visible and UV spectroscopy - absorption of chromophores - chemical analysis by visible and UV light – applications to protein and nucleic acid structures with respect to denaturation .

ORD and CD : Principles of optical activity - Cotton effect - relation between ORD and CD - physical origins - application to estimation of secondary structures in proteins – structural characterization of nucleic acids.

NMR spectroscopy : General principles - classical picture - resonance condition - Bloch equations - relaxation phenomena and measurements - effect of relaxation times on line-width - Fourier transform technique - chemical shifts - coupling constants - Karplus equation - NOE effects - Proton magnetic resonance (PMR), spectra of amino acids and peptides - conformation of amino acids and peptides - application to proteins with reference to helix coil transition and denaturation - PMR applications to characterization of base pairs and nucleotide conformation.

Fluorescence spectroscopy : Basic principles - experimental set up - chromophores in biological systems - applications.

PHY C006	Physical Studies of Macro – - molecules in Solution	C	3	1	0	4	DV

Chemical Thermodynamics, statistics of linear polymers, osmotic pressure, diffusion, light scattering, viscosity, electrophoresis, chromatography.

Thermodynamics: Fundamental principles of the thermodynamics of solutions - partial molal and partial specific volumes - chemical potential in ideal and real solution - colligative properties and molecular weight - the total free energy of a solution - excluded volume for dilute solutions & flexible polymers.

Statistics of linear polymers: Molecular weight averages and distributions - average dimensions – end-to-end distance - radius of gyration - interaction between polymer segments and solvent molecules and its effect on the end-to-end distance.

Osmotic pressure: Principles of osmotic pressure - van't Hoff's law - concentration dependence of osmotic pressure - effect of electrostatic charge on the thermodynamic behaviour in solution - equilibrium across a semi-permeable membrane - Donnan effect - osmotic pressure of solutions containing macro ions - osmotic pressure

of protein solutions - membrane potentials - phase equilibria - solubility and freezing point - melting points of crystalline polymers - solubility of crystalline proteins.
Diffusion: Macromolecular diffusion - Fick's law of diffusion - experimental determination of diffusion coefficients - Einstein and Sutherland equation. Ultracentrifugation: General principles - Lamm's equation - Svedberg equation - sedimentation velocity - sedimentation equilibrium - determination of molecular weight from sedimentation data - shape information from sedimentation data - density gradient methods - molecular weight averages - applications of the analytical ultracentrifuge.
Light Scattering: Elastic and inelastic scattering - light scattering by macromolecules - Zimm plot - estimation of chain dimensions - experimental results on some proteins and nucleic acids. Low angle X-ray scattering: General principles - determination of radius of gyration and end to end distance.
Viscosity: General principles - frictional coefficient - Newtonian flow - Poiseuille's law for capillary flow - experimental measurement of the viscosity of liquids - specific and intrinsic viscosites - Einstein-Simha equation for the viscosity of suspensions - applications of viscosity measurements.
Electrophoresis : Principles of electrophoresis - factors affecting electrophoresis - micro electrophoresis - its applications - moving boundary electrophoresis - course electrophoresis - slab gel electrophoresis and tube gel electrophoresis - separation of macromolecules and other applications - isoelectric focussing and isotachophoresis - preparative electrophoresis.
Chromatography: General principles - paper chromatography - TLC - column chromatography - gas, liquid chromatography - ion exchange chromatography - exclusion chromatography - affinity chromatography - high performance liquid chromatography - applications to macromolecules.

PHY C007	Molecular Biology of Gene	C	4	0	0	4	NG/PK

PHY E004	Algorithms and Data Bases in Bioinforamtics	E	2	1	0	3	NG

The use of computers in Biology – digital nature of biological information – elements of computer science – databases – algorithms for sequence and structure analysis, structure and classification , applications.
Introduction: The uses of computers in Biology - sequence projects - structure projects - functional genomics, structural genomics.
Databases : Computer databases - biomolecular databases - sequence databases - structure databases - - details of organisation, access, methods of deposition - derived, specialized databases - data retrieval - data mining.
Algorithms : Algorithms for analysis and usage of sequence databases - homology v/s similarity - dot matrices - dynamic programming - Needleman and Wunsch method - Hash coding methods - BLAST and PSIBLAST - multiple sequence alignment - phylogenetic trees - Hidden Markov models.
Structure and Classification : Algorithm for analysis and usage of structure databases - structure comparisons - superposition - dynamic programming - structural classification of proteins - sequence specific DNA structure.
Applications : Miscellaneous and Advanced topics in Bioinformatic - RNA secondary structure prediction - RNA folding - Homology modeling of proteins - Examples of applications of Bioinformatics tools - The human genome projects -Ethical and socialogical issues.

PHY E005	Basic Crystallography	E	2	1	0	3	MNP

Elementary Crystallography : External features and symmetry – unit cell and Miller indices –crystal systems – Bravais lattices – point groups and space groups – X-ray diffraction – Laue equations – Bragg's law – reciprocal lattice and its application to geometrical Crystallography.
X-ray scattering : Atomic scattering factor – diffraction by a space lattice – structure factor equation – electron density and Fourier series – Fourier Transform and crystal diffraction – diffraction by real crystals – Lorentz and polarization factor – primary and secondary extinctions.
Experimental methods : Generation, detection and properties of X-rays – filters – monochromators – absorption coefficients – choice of radiation, synchrotron radiation. Powder, Laue, Weissenberg and precession methods; area detectors and image plates.
Structure Determination: Intensity estimation and deduction of structure factor amplitudes – Wilson plot – scale and temperature factors – Anomalous scattering and violation of Friedel's law – absolute configuration.
Fibre Diffraction : Theory of diffraction by helical structures and application to alpha-helix and DNA.
Crystal systems and space groups, X-ray scattering, techniques of X-ray generation, recording of diffraction patterns, Symmetry deduction, absolute configuration, powder & fibre diffraction..

PHY E008	Numerical Methods	C	2	1	0	3	KSG

Roots of equations, simultaneous linear equations, numerical integration, Approximation methods and algorithms.

Roots of Equations : - Method of successive approximation - the Newton-Raphson method - roots of polynomials - Bairstow's method

Simultaneous linear equations: - Gaussian elimination with pivoting, Gauss-Seidel iterative method of solutions.

Numerical integration : - trapezoidal rule - Simpson's rule, Romberg algorithm – Monte - Carlo methods.

Approximation Methods : Approximation by spline function - cubic interpolatory spline. Method of least squares - normal equation application to linear and polynominal curve fitting.

Algorithms : – sorting – random number generation – searching – Optimization – Simplex method – combinatorial optimization – gradient methods – molecular dynamics – Verlet dynamics.

PHY C009	Seminars in Biophysics	C	0	3	0	3	GS/SSR/ NG

Students will be giving seminar talks on topics in Biophysics.

Students are required to give seminars on advanced topics in Biophysics and related topics - They are also required to attend Guest lectures / Seminars organised by the department. Students will be evaluated by a faculty committee in a manner similar to Theory papers.

PHY C010	Basic Statistics	C	2	1	0	3	DV

Introduction - mean, median & mode, probability, random variables, probability distribution, hypothesis testing, non-parametric tests.

Introduction : Statistics - Population - sample - summarizing data in tables and graphs - histogram - frequency polygons - ogives; bar diagram - pie chart - stem and leaf plot – Box and Whisker plot.

Descriptive Statistics: Arithmetic mean, geometric mean, - harmonic mean, median, mode, standard deviation - Root mean square deviation range - quartiles, percentiles - skewness and kurtosis - coefficient of variation - bivariate data - covariance - correlation coefficient.

Probability: Sample space and events - axioms of probability theory - addition and multiplication theorems - conditional probability - law of total probability - Bayes' theorem - independence of events – entropy (basic ideas)

Random Variables: Discrete and continuous random variables - probability mass function and probability density function -cumulative function -mean, moments and variance of distributions - change of variables for univariance - probability integral transformation - Chebyshev's theorem (no proof) - covariance and correlation of two random variables.

Probability Distributions: Binomial, Poisson and normal distributions and their properties and applications - Poisson approximation to binomial distribution - normal approximation to binomial distribution - normal or gaussian approximation to Poisson distribution - central limit theorem (statement only) -systematic and random errors - propagation of errors.

Sampling distributions of the sample mean, sample proportion and difference between two sample means - Student's t-distribution - F-distribution - Estimation: Point estimation and interval estimation - properties of estimators - maximum likelihood and moments methods of estimation.

Hypothesis Testing: One sample inference - type I and type II errors - one sample test for the mean of a normal distribution with known variance - one tailed and two tailed tests - power of the test - test of simple hypotheses employing t-distribution - chi-squares test for goodness of fit. Hypothesis testing of proportion: large samples - two sample tests for differences between means and for differences between proportions - one way analysis of variance - regression and correlation methods - fitting straight lines by the principle of least squares.

Non-Parametric Tests: The sign test - Mann-Whitney U-test - one-sample runs test - Krushkal-Wallis H-test - Spearman's rank correlation coefficient.

PHY C011	Macromolecular Crystallography	C	2	1	0	3	SSR/NG

Macromolecular crystallization techniques, Mounting the crystals, structure solution and refinement, interpretation of results.

Crystallization : Protein crystallization techniques - preparation of heavy atom derivatives

Mounting the crystals - Data Collection - MAD measurements, synchrotron radiation, Area detectors and Image Plates.

Structure solution methods : Determination of heavy atom positions - correlation of origins - phase calculations using isomorphous replacement and anomalous dispersion methods - multiple wave length anomalous dispersion methods – Molecular replacement

Structure refinement: Difference Fourier methods -low, medium and high resolution electron density maps - density modification - refinement of models - least squares technique - weighting schemes - R-indices - rigid body refinement - restrained and constrained refinement -solvent flattening and omit maps - molecular dynamics refinement.

PHY C012	Crystallography Laboratory	C	0	0	3	3	MNP

Students have to perform the prescribed experiments in crystallography.

1. Tests for Centrosymmentry.
2. Wilson plot.
3. Structure factor calculations.
4. Phasing Procedure I - Centrosymmetric case
5. Phasing Procedure II - Non-centrosymmetric case
6. Bond lengths and Bond angles calculation.
7. Conformations of the ring systems.
8. SHELXS 97 - Crystal structure analysis
9. SHELXL 97 - Crystal structure refinement
10. SIR 97 - Semi variant representation approach for structure determination
11. PARST - Analysis of Intra and Intermolecular features.
12. ZORTEP - Thermal ellipsoid analysis
13. Date Collection and Structure determination using CAD4 diffractometer.
14. Identification of Samples using Powder Photographs.
15. Determination of Unit all parameters – Powder Photograph.
16. Crystallization and Crystal mounting.

PHY E006	Biophysics of the Immune System	E	2	1	0	3	Guest Faculty

Celluar basis of Immune response - T and B Lymphoctes - antibodies - antigens - T cell receptors.

Cellular basis of immune response - general properties of the immune system - humoral and cell-mediated immunity - T and B lymphocytes - immunoglobulins (antibodies) - antigens - haptens and epitopes - immunological memory.

Antibodies - structural classes - light and heavy chains - variable and hypervariable regions - antigen binding site - three-dimensional structure of antibodies - structural basis of antigen binding to antibody - monoclonal antibodies.

Generation of antibody specificity - instructive and selective theories - clonal selection theory - organisation and expression of the antibody genes - Mechanism of generation of antibody diversity - germline, somatic recombination and somatic mutation hypothesis.

T cell receptors - Major histocompatibility complex proteins - the complement system - pathways - regulation of immune responses - hypersensitivity - autoimmunity.

PHY E007	Theory and Practice of Direct Methods of solving structures	E	2	1	0	3	DV

Crystallographic statistics - Direct Methods - Tangent formula - use of quarterts - Structural Data Base

Basic Concepts in Crystallography:

Basic concepts in crystallography – Crystallographic statistics – Phase problem – Direct Methods – Origin definition – Structure invariants and semi-invariants – Sayre's equation – Tangent formula – Hand propagation – Use of quarterts.

Difference stages of Structure Determination:

Various stages in the structure determination of small molecules using Direct Methods – Limitations of Direct Methods.

Use of SHELXS Package:

Demonstration of the program package SHELXS for solving a small molecule – Refinement of structures – Analysis of structural features.

Computer Programmes for Analysis of results:

Usage of computer programs to actually determine the three-dimensional structure of a small molecule and to analysis the results.

Interpretation of results:

Structure – Function relationship of some small molecules – Cambridge Structural Database.

PHY C013	Project Work	C	0	0	6	6	All Faculty

Each student will submit a Project Report on a chosen topic under the guidance of a Supervisor. One semester project work under the guidance of a faculty member. The student is required to carry out individual experimental / computational work and submit a dissertation. The work carried out is to be presented before a committee of faculty members for evaluation followed by Viva – Voce Examination

PHY C014	Membrane Biophysics & Neuro Biophysics	C	2	1	0	3	MNP

Membrane constituents and structure, membrane potentials, Ion transport, nerve cells, sensory systems, and mechanism of action.

Membrane Constituents : Review of chemistry and biochemistry of constituents of membranes - lipids, phospholipids, lipoproteins, models of membrane structure.

Nervous System : Organisation of the nervous system - Membrane potentials - origins of membrane potential - electrochemical potentials - Donnan equilibrium - Nernst equation - Goldman equation.

Ion Transport : Membrane transport - diffusion-facilitated diffusion - membrane transport proteins - carrier mediated transport - channel mediated transport.

Nerve Cells : Excitable tissues - nerve and muscle cells - nerve conduction - the generation and transmission of the Action Potential - The Hodgkin-Huxley model – Voltage-gated channels - patchclamp technique. The synapse - transmission of impulses across synaptic junctions - neurotransmitters and their mechanism of action.

Volume conduction - electrical activity of the heart - electrocardiography - Other body potentials used in medical diagnosis - EEG, EMG.

Sensory Systems : Anatomy and physiology of the ear - neural mechanisms of hearing.

Anatomy of the eye - threshold of acuity. Neural aspects of vision - colour discrimination - molecular basis of vision - rhodopsin and other photopigments.

PHY C015	Biophysics Laboratory	C	0	0	3	3	SSR

Students have to perform the prescribed experiments in Biophysics

Crystallisation, preparation and mounting of crystals.
Optical rotation (Specific rotation of sugar)
Viscosity measurement.
Column chromatography.
Thin Layer Chromatography
Critical solution temperature.
Electrophoresis.
Model building using Byron's Bender.
Denaturation of proteins using UV-spectroscopy.
Melting temperature of DNA.
Infrared studies of aminoacids
Interpretation of NMR spectra
Concentration measurements of macromolecules
Protein crystallization
UV – absorption studies

ELECTIVE COURSES OFFERED

1. Computational Biology
2. Object
3. Oriented Languages
4. Fundamentals of Molecular Spectroscopy
   (Offered only for other Department Students)
5. Algorithms and Data Bases in Bioinformatics
6. Basic Crystallography
   (Offered only for other Department Students)
7. Biophysics of the Immune Systems
8. Theory and Practice of Direct Methods of solving Crystal Structure

PHY C001	Elementary Crystallography	**C**	2	1	0	3	PK

Elementary Crystallography : External features and symmetry – unit cell and Miller indices –crystal systems – Bravais lattices – point groups and space groups – X-ray diffraction – Laue equations – Bragg's law – reciprocal lattice and its application to geometrical Crystallography.

X-ray scattering : Atomic scattering factor – diffraction by a space lattice – structure factor equation – electron density and Fourier series – Fourier Transform and crystal diffraction – diffraction by real crystals – Lorentz and polarization factor – primary and secondary extinctions.

Experimental methods : Generation, detection and properties of X-rays – filters – monochromators – absorption coefficients – choice of radiation, synchrotron radiation - Outlines of Powder, Laue, Weissenberg and precession methods - interpretation of powder photograph – ASTM index - Intensity estimation and deduction of structure factor amplitudes – Wilson plot – scale and temperature factors – symmetry deduction and determination of space groups – test for centrosymmetry – use of intensity statistics in space group determination - Anomalous scattering and violation of Friedel's law – absolute configuration.

Fibre Diffraction : Theory of diffraction by helical structures and application to alpha-helix and DNA.

Elements of electron and neutron diffraction : principles of neutron scattering - neutron scattering lengths - applications of neutron scattering techniques in crystal structure analysis - comparison of X -ray and neutron scattering.

PHY C002	Principles of Macromolecular Structure & Function	**C**	4	0	0	4	NG/PK

Stereochemistry and concepts of conformation : Asymmetric carbon atom - optical, geometric stereoisomerism - chirality - Fischer convention - L and D residues - torsion angle - hindered rotation.

Conformational analysis : van der Waal's radii or effective nonbonded radii of atoms - contact distance criteria - Noncovalent forces determining biopolymer structure – dispersion forces – electrostatic interactions – van der Waal's interactions - hydrogen bonds - hydrophobic interactions - distortional energies - description of various interactions by potential functions - elementary ideas of minimization of conformational energy and molecular dynamics.

Principles of protein structure : Structural implications **-** Concept of rigid planar peptide unit - *cis* and *trans* configuration – conformation of a pair of linked peptide units - torsion angles phi and psi - steric hindrance - hardsphere approximation - allowed and disallowed conformations - Ramachandran Diagram - specific effects of proline and glyline - conformationally constrained amino acids and their importance.

Levels of organization of polypeptide chains : primary, secondary, tertiary and quaternary structures - types of secondary structures - alpha helix, beta sheet, reverse turns – Super secondary structures – alpha, beta and alpha / beta classification of proteins.

Structure of fibrous proteins : Structure of collagen - structure of silk and wool , structure muscle protein and mechanism of muscle contraction.

Structure and function of globular proteins : Structure and action of myoglobin, hemoglobin, lysozyme, chymotrypsin, pepsin, dehydrogenases - enzyme - substrate interactions.

Protein folding : Anfinsen's principle - Levinthal paradox – Semi empirical Methods of protein structure prediction - Molten globular states – conformational intermediates – chaperones and their function .

Principles of nucleic acid structure : Conformations of nucleosides and nucleotides- Watson and Crick's base-pairings and their implications. Non Watson and Crick pairing schemes - base stacking interactions - DNA polymorphism - structure of ADNA, BDNA and ZDNA - helical transitions. Non-uniform helical DNA Structure.

Unusual DNA structures - hairpins, bulges, cruciform, triplexes, tetraplexes.

Structure of RNA and RNA - DNA hybrid duplexes - Structure of tRNA - Structure of Hammer head ribozymes. Elementary ideas of secondary and tertiary structures of large RNA's.

Principles of polysaccharide structure : Stereoisomerism of hexapyranose sugars - conformation of mono and disaccharides - structures of maltose, cellobiose and laminaribiose and their polymers - bacterial cell wall polysaccharides.

Structure of macromolecular assembly : Principles of packing of protein subunits in rod and spherical viruses - structure of chromatin – Elementary ideas of the Structure of 50s and 30s ribosomal particles.

PHY C003	Mathematical Physics	**C**	4	0	0	4	NG/PK

PHY E001	Computational Biology	**E**	2	1	0	3	NG

Strings, graphs and algorithms

General concept of a string – DNA and protein sequences as strings – string operatijons – prefixes and suffixes – definition of graphs – classification of graphs – algorithms – definitions – P, NP, NP-hard and NP-complete algorithms

Probability theory

Introduction – simple ideas about distributions – discrete distributions (Bernoulli, Binomial, Uniform, Geometric, and Poisson) – continuous distributions (Uniform, Normal, Exponential, Gamma and Beta) – Statistical inference – Introduction to classical and Bayesian inference

Algorithms on strings

Sequence comparison and database searching – global, local and semiglobal comparison – DNA fragment assembly – the ideal case and complications – phylogenetic tree construction – parsimony – RNA secondary structure prediction

Molecular simulation and dynamics

Basic molecular dynamics – equations of motion – potential functions – integration computations – Initial state – boundary conditions – equilibration – dynamics protocols – trajectories – analyses of results – AMBER, CHARMm, - simple applications to proteins and nucleic acids

Miscellaneous topics

Micro arrays and analyses – DNA computing – Hamiltonian path problem – systems biology – interaction and metabolic networks in cells – whole cell simulations – E-cell and V-cell.

PHY E002	Object Oriented Languages	**E**	2	1	0	3	Guest faculty

Characteristic of object oriented languages – C ++ programming basics – loops and Decisions – Structures – functions - Objects and classes – arrays – operator overloading – Inheritance – pointers – Virtual and tuned functions - Files and streams – Turbo C++ class library - Genesis of Java – overview – Data types, variables and analysis – Operators – Control statements – Methods & classes – Inheritance- Exception handling multi-threaded programming – I/o, Applets and string handling – Networking – Event handling - Java Beans – Swing – Servlets – Migrating from C++ to Java - Oracle fundamentals – Queries SQL functions OOP concepts in oracle – Java in oracle.

PHY E003	Fundamentals of Molecular Spectroscopy (offered for other Departments only)	**E**	2	1	0	3	GS

Introduction: Characterization of electromagnetic radiation – quantization of energy, Regions of the electromagnetic spectrum – Basic elements of practical spectroscopy.

Microwave Spectroscopy: The pure rotation of molecules - classification of rotors – rotational spectra of diatomic and simple polyatomic molecules as rigid and non- rigid rotors- Techniques and instrumentaion.

Infrared Spectroscopy: The vibrating diatomic molecule – Diatomic vibrating – rotator – Rotation - vibration spectrum of diatomic molecules – Breakdown of Born – Oppenheimer approximation – Interaction of rotation and vibration – vibrations of polyatomic molecules – Influence of rotation on the spectra of polyatomic molecules – Techniques and Instrumentation. Principles of Fourier Transform Infrared Spectroscopy.

Raman Spectroscopy: Introduction - Polarization of light and Raman effect- pure rotational Raman spectrum – vibrational Raman spectrum –. Techniques and Instrumentation. Principles of Laser Raman Spectroscopy.

Structure determination of simple molecules from Raman and infrared spectroscopy.

PHY C004	Methods of X – Ray Crystal Structure Determination	**C**	3	1	0	4	SSR

Methods of structure analysis : Phase problem in crystallography - methods of its solution - electron density function, weighting function - convolution theorem.

Patterson Methods : Patterson function and its interpretation - heavy atom method - Patterson search - Patterson methods - techniques - rotation search - translation search.

Direct methods : Unitary and normalized structure factors - Harker-Kasper inequalities - Sayre's relations - general phase and probability relations - structure invariants and semi-invariants - symbolic addition methods - tangent formula - multisolution methods - maximum determinant method - maximum entropy methods.

Refinement : Fourier refinement - least-squares techniques of refinement .

Interpretation of the results : Bond lengths - bond angles- torsion angles - conformation - accuracy and reliability of the results, thermal motion analysis - Interpretation of results - Crystallographic information file - data bases.

PHY C005	Principles and Applications of Spectroscopy to Biomolecules	**C**	3	1	0	4	GS/KSG

Infrared spectroscopy : General principles of spectroscopy - origins of rotational and vibrational spectra - anharmonic oscillator - molecular symmetry - overtone and combination bands - experimental aspects and methods - optical density - investigation of molecular structure with special reference to deuterium exchange, hydrogen bonding - dichroism and crystallinity measurements - applications to polypeptides and proteins - chemical bonding of metal ions to proteins - applications to nucleic acids and polysaccharides, principles of FTIR spectroscopy - advantages.

Raman spectroscopy : Principles - experimental aspects - advantages of Raman spectroscopy - Laser as Raman source - advantages - Raman spectra of amino acids - application to proteins and nucleic acids - Laser Raman spectroscopy.

Absorption spectroscopy : Principles - experimental aspects of visible and UV spectroscopy - absorption of chromophores - chemical analysis by visible and UV light – applications to protein and nucleic acid structures with respect to denaturation .

ORD and CD : Principles of optical activity - Cotton effect - relation between ORD and CD - physical origins - application to estimation of secondary structures in proteins – structural characterization of nucleic acids.

NMR spectroscopy : General principles - classical picture - resonance condition - Bloch equations - relaxation phenomena and measurements - effect of relaxation times on line-width - Fourier transform technique - chemical shifts - coupling constants Karplus equation - NOE effects - Proton magnetic resonance (PMR), spectra of amino acids and peptides - conformation of amino acids and peptides - application to proteins with reference to helix coil transition and denaturation - PMR applications to characterization of base pairs and nucleotide conformation.

Fluorescence spectroscopy : Basic principles - experimental set up - chromophores in biological systems - applications.

PHY C006	Physical Studies of Macro – - molecules in Solution	**C**	3	1	0	4	DV

Thermodynamics: Fundamental principles of the thermodynamics of solutions - partial molal and partial specific volumes - chemical potential in ideal and real solution - colligative properties and molecular weight - the total free energy of a solution - excluded volume for dilute solutions & flexible polymers.

Statistics of linear polymers: Molecular weight averages and distributions - average dimensions – end-to-end distance - radius of gyration - interaction between polymer segments and solvent molecules and its effect on the end-to-end distance.

Osmotic pressure: Principles of osmotic pressure - van't Hoff's law - concentration dependence of osmotic pressure - effect of electrostatic charge on the thermodynamic behaviour in solution - equilibrium across a semi-permeable membrane - Donnan effect - osmotic pressure of solutions containing macro ions - osmotic pressure of protein solutions - membrane potentials - phase equilibria - solubility and freezing point - melting points of crystalline polymers - solubility of crystalline proteins.

Diffusion: Macromolecular diffusion - Fick's law of diffusion - experimental determination of diffusion coefficients - Einstein and Sutherland equation. Ultracentrifugation: General principles - Lamm's equation - Svedberg equation - sedimentation velocity - sedimentation equilibrium - determination of molecular weight from sedimentation data - shape information from sedimentation data - density gradient methods - molecular weight averages - applications of the analytical ultracentrifuge.

Light Scattering: Elastic and inelastic scattering - light scattering by macromolecules - Zimm plot - estimation of chain dimensions - experimental results on some proteins and nucleic acids. Low angle X-ray scattering: General principles - determination of radius of gyration and end to end distance.

Viscosity: General principles - frictional coefficient - Newtonian flow - Poiseuille's law for capillary flow - experimental measurement of the viscosity of liquids - specific and intrinsic viscosites - Einstein-Simha equation for the viscosity of suspensions - applications of viscosity measurements.

Electrophoresis : Principles of electrophoresis - factors affecting electrophoresis - micro electrophoresis - its applications - moving boundary electrophoresis - course electrophoresis - slab gel electrophoresis and tube gel electrophoresis - separation of macromolecules and other applications - isoelectric focussing and isotachophoresis - preparative electrophoresis.

Chromatography: General principles - paper chromatography - TLC - column chromatography - gas, liquid chromatography - ion exchange chromatography - exclusion chromatography - affinity chromatography - high performance liquid chromatography - applications to macromolecules.

PHY C007	Molecular Biology of Gene	**C**	4	0	0	4	NG/PK

PHY E004	Algorithms and Data Bases in Bioinformatics	**E**	2	1	0	3	NG

Introduction: The uses of computers in Biology - sequence projects - structure projects - functional genomics, structural genomics.

Databases : Computer databases - biomolecular databases - sequence databases - structure databases - - details of organisation, access, methods of deposition - derived, specialized databases - data retrieval - data mining.

Algorithms : Algorithms for analysis and usage of sequence databases - homology v/s similarity - dot matrices - dynamic programming - Needleman and Wunsch method - Hash coding methods - BLAST and PSIBLAST - multiple sequence alignment - phylogenetic trees - Hidden Markov models.

Structure and Classification : Algorithm for analysis and usage of structure databases - structure comparisons - superposition - dynamic programming - structural classification of proteins - sequence specific DNA structure.

Applications : Miscellaneous and Advanced topics in Bioinformatic - RNA secondary structure prediction - RNA folding - Homology modeling of proteins - Examples of applications of Bioinformatics tools - The human genome projects -Ethical and socialogical issues.

PHY E005	Basic Crystallography	**E**	2	1	0	3	MNP

PHY C012	Crystallography Laboratory	**C**	0	0	3	3	MNP

Elementary Crystallography : External features and symmetry – unit cell and Miller indices –crystal systems – Bravais lattices – point groups and space groups – X-ray diffraction – Laue equations – Bragg's law – reciprocal lattice and its application to geometrical Crystallography.

X-ray scattering : Atomic scattering factor – diffraction by a space lattice – structure factor equation – electron density and Fourier series – Fourier Transform and crystal diffraction – diffraction by real crystals – Lorentz and polarization factor – primary and secondary extinctions.

Experimental methods : Generation, detection and properties of X-rays – filters – monochromators – absorption coefficients – choice of radiation, synchrotron radiation. Powder, Laue, Weissenberg and precession methods; area detectors and image plates.

Structure Determination: Intensity estimation and deduction of structure factor amplitudes – Wilson plot – scale and temperature factors – Anomalous scattering and violation of Friedel's law – absolute configuration.

Fibre Diffraction : Theory of diffraction by helical structures and application to alpha-helix and DNA.

1.Tests for Centrosymmentry.
2.Wilson plot.
3.Structure factor calculations.
4.Phasing Procedure I - Centrosymmetric case
5.Phasing Procedure II - Non-centrosymmetric case
6.Bond lengths and Bond angles calculation.
7.Conformations of the ring systems.
8.SHELXS 97 - Crystal structure analysis
9.SHELXL 97 - Crystal structure refinement
10.SIR 97 - Semi variant representation approach for structure determination
11.PARST - Analysis of Intra and Intermolecular features.
12.ZORTEP - Thermal ellipsoid analysis
13.Date Collection and Structure determination using CAD4 diffractometer.
14.Identification of Samples using Powder Photographs.
15.Determination of Unit all parameters – Powder Photograph.
16.Crystallization and Crystal mounting.

PHY C008	Numerical Methods	**C**	2	1	0	3	KSG

Roots of Equations : - Method of successive approximation - the Newton-Raphson method - roots of polynomials - Bairstow's method

Simultaneous linear equations: - Gaussian elimination with pivoting, Gauss-Seidel iterative method of solutions.

Numerical integration : - trapezoidal rule - Simpson's rule, Romberg algorithm – Monte - Carlo methods.

Approximation Methods : Approximation by spline function - cubic interpolatory spline. Method of least squares - normal equation application to linear and polynominal curve fitting.

Algorithms : – sorting – random number generation – searching – Optimization – Simplex method – combinatorial optimization – gradient methods – molecular dynamics – Verlet dynamics.

PHY C009	Seminars in Biophysics	**C**	0	3	0	3	GS/SSR/NG

Students are required to give seminars on advanced topics in Biophysics and related topics - They are also required to attend Guest lectures / Seminars organised by the department. Students will be evaluated by a faculty committee in a manner similar to Theory papers.

PHY C010	Basic Statistics	**C**	2	1	0	3	DV

Introduction : Statistics - Population - sample - summarizing data in tables and graphs - histogram - frequency polygons - ogives; bar diagram - pie chart - stem and leaf plot – Box and Whisker plot.

Descriptive Statistics: Arithmetic mean, geometric mean, - harmonic mean, median, mode, standard deviation - Root mean square deviation range - quartiles, percentiles - skewness and kurtosis - coefficient of variation - bivariate data - covariance - correlation coefficient.

Probability: Sample space and events - axioms of probability theory - addition and multiplication theorems - conditional probability - law of total probability - Bayes' theorem - independence of events – entropy (basic ideas)

Random Variables: Discrete and continuous random variables - probability mass function and probability density function -cumulative function -mean, moments and variance of distributions - change of variables for univariance - probability integral transformation - Chebyshev's theorem (no proof) - covariance and correlation of two random variables.

Probability Distributions: Binomial, Poisson and normal distributions and their properties and applications - Poisson approximation to binomial distribution - normal approximation to binomial distribution - normal or gaussian approximation to Poisson distribution - central limit theorem (statement only) -systematic and random errors - propagation of errors - Sampling distributions of the sample mean, sample proportion and difference between two sample means - Student's t-distribution - F-distribution - Estimation: Point estimation and interval estimation - properties of estimators - maximum likelihood and moments methods of estimation.

Hypothesis Testing: One sample inference - type I and type II errors - one sample test for the mean of a normal distribution with known variance - one tailed and two tailed tests - power of the test - test of simple hypotheses employing t-distribution - chi-squares test for goodness of fit. Hypothesis testing of proportion: large samples - two sample tests for differences between means and for differences between proportions - one way analysis of variance - regression and correlation methods - fitting straight lines by the principle of least squares.

Non-Parametric Tests: The sign test - Mann-Whitney U-test - one-sample runs test - Krushkal-Wallis H-test - Spearman's rank correlation coefficient.

PHY C011	Macromolecular Crystallography	C	2	1	0	3	SSR/NG

Crystallization : Protein crystallization techniques - preparation of heavy atom derivatives

Mounting the crystals - Data Collection - MAD measurements, synchrotron radiation, Area detectors and Image Plates.

Structure solution methods : Determination of heavy atom positions - correlation of origins - phase calculations using isomorphous replacement and anomalous dispersion methods - multiple wave length anomalous dispersion methods – Molecular replacement

Structure refinement: Difference Fourier methods -low, medium and high resolution electron density maps - density modification - refinement of models - least squares technique - weighting schemes - R-indices - rigid body refinement - restrained and constrained refinement -solvent flattening and omit maps - molecular dynamics refinement.

Interpretation of results : PROCHECK, - Ramachandran plot – rms deviations.

PHY C012	Crystallography Laboratory	C	0	0	3	3	MNP

PHY E006	Biophysics of the Immune System	E	2	1	0	3	Guest Faculty

Cellular basis of immune response - general properties of the immune system - humoral and cell-mediated immunity - T and B lymphocytes - immunoglobulins (antibodies) - antigens - haptens and epitopes - immunological memory - Antibodies - structural classes - light and heavy chains - variable and hypervariable

regions - antigen binding site - three-dimensional structure of antibodies - structural basis of antigen binding to antibody - monoclonal antibodies - Generation of antibody specificity - instructive and selective theories - clonal selection theory - organisation and expression of the antibody genes - Mechanism of generation of antibody diversity - germline, somatic recombination and somatic mutation hypothesis - T cell receptors - Major histocompatibility complex proteins - the complement system - pathways - regulation of immune responses - hypersensitivity - autoimmunity.

PHY E007	Theory and Practice of Direct Methods of solving structures	E	2	1	0	3	DV

Basic Concepts in Crystallography:

Basic concepts in crystallography – Crystallographic statistics – Phase problem – Direct Methods – Origin definition – Structure invariants and semi-invariants – Sayre's equation – Tangent formula – Hand propagation – Use of quarterts.

Difference stages of Structure Determination:

Various stages in the structure determination of small molecules using Direct Methods – Limitations of Direct Methods.

Use of SHELXS Package:

Demonstration of the program package SHELXS for solving a small molecule – Refinement of structures – Analysis of structural features.

Computer Programmes for Analysis of results:

Usage of computer programs to actually determine the three-dimensional structure of a small molecule and to analysis the results.

Interpretation of results:

Structure – Function relationship of some small molecules – Cambridge Structural Database.

PHY C013	Project Work	C	0	0	6	6	All Faculty

One semester project work under the guidance of a faculty member. The student is required to carry out individual experimental / computational work and submit a dissertation. The work carried out is to be presented before a committee of faculty members for evaluation followed by Viva – Voce Examination.

PHY C014	Membrane Biophysics & Neuro Biophysics	**C**	2	1	0	3	MNP

Membrane Constituents : Review of chemistry and biochemistry of constituents of membranes - lipids, phospholipids, lipoproteins, models of membrane structure - Nervous System : Organisation of the nervous system - Membrane potentials - origins of membrane potential - electrochemical potentials - Donnan equilibrium - Nernst equation - Goldman equation - Ion Transport : Membrane transport - diffusion-facilitated diffusion - membrane transport proteins - carrier mediated transport - channel mediated transport - Nerve Cells : Excitable tissues - nerve and muscle cells - nerve conduction - the generation and transmission of the Action Potential - The Hodgkin-Huxley model – Voltage-gated channels - patchclamp technique - The synapse - transmission of impulses across synaptic junctions - neurotransmitters and their mechanism of action - Volume conduction - electrical activity of the heart - electrocardiography - Other body potentials used in medical diagnosis - EEG, EMG - Sensory Systems : Anatomy and physiology of the ear - neural mechanisms of hearing - Anatomy of the eye - threshold of acuity. Neural aspects of vision - colour discrimination - molecular basis of vision - rhodopsin and other photopigments.

PHY C015	Biophysics Laboratory	**C**	0	0	3	3	SSR

1. Crystallisation, preparation and mounting of crystals.
2. Optical rotation (Specific rotation of sugar)
3. Viscosity measurement.
4. Column chromatography.
5. Thin Layer Chromatography
6. Critical solution temperature.
7. Electrophoresis.
8. Model building using Byron's Bender
9. Denaturation of proteins using UV-spectroscopy.
10. Melting temperature of DNA.
11. Infrared studies of aminoacids

12. Interpretation of NMR spectra
13. Concentration measurements of macromolecules
14. Protein crystallization
15. UV – absorption studies

Evaluation of Project Work

PHY	Radiation Biophysics	**3**				3	SSR

Radiation Physics: Radiation Quantities, units and definitions – Radiation energy and measurement.

Radioactivity : Radioactivity measurements - Law of Radioactivity - Radioactive decay of mixtures - Charting of Decay schemes - Nuclear stability - Radioactive decay by alpha particle - Beta decay - positron decay - electron capture - internal conversion - Auger, electron.

Radiation in Biological Systems : Radiation Biology of Normal tissue and Neoplastic system - Biological effects of ionizing radiation - structural changes in chromosomes - Gene muatation - metabolism and biologial effects of radionuclide - Radiation hazards, Evaluation and control - Regulatory aspects of radiological safety - disposal of radioactive wastes.

Lasers and Imaging : Physics of laser - different types of lasers - biomedical applications - C.T. scan - ultra sonography. - NMR Imaging – Principles – Applications.

PHY	Trends In Genomics	**E**				3	SSR

(The course will describe and explain recent advances in biology. It will give an overview of the current paradigms that underlie biology. It will describe the methods and techniques of proteome and genome research.)

Introduction and Definitions : The living cell as an information processing machine – storage, transfer and utilization of information – overview of cell processes – nucleic acids, DNA, RNA, proteins and other biologically important molecules – the central dogma of molecular biology – gene, genome, genomics – proteins, porteome, proteomics.

Genomics : Gene and genome structure – transcription – replication – synthesis and processing of RNA – regulation of genome activity – genome evolution – mutations – DNA repair – recombination – horizontal transfer of genes – the human genome.

Gene technology : Genetic mapping – RFLP, SSLP, SNP – restriction mapping – fluorescent in situ hybridization – gene sequencing – chain termination DNA sequencing – shotgun sequencing – whole genome sequencing – assembly of contigs – case studies about whole genome sequencing.

Gene analysis : Identifying genes – ORF –experimental and computational techniques for locating genes – assigning gene function – homology analysis – comparative genomics – functional genomics – pattern of gene expression – cDNA microarray analysis.

Proteomics : Methods of protein characterization – Gel electrophoresis – 2D gel electrophoresis – western blotting – Edman protein microsequencing – protein sequencing – peptide mass fingerprinting – MALDI – TOF MS-peptide microarrays.

M. SC. PHYSICS

COURSE Code	Title of the course	C/E	Credits				Name of the Faculty
			L	T	P	C	
Semester I							
PHY C101	Mathematical Physics I	C	3	1	0	4	M. Seetharaman
PHY C102	Analog Electronics	C	2	1	0	3	C. Venkateswaran
PHY C103	Digital and Nuclear Electronics	C	2	1	0	3	K. Sivaji
PHY C104	Classical Mechanics	C	2	1	0	3	S. S. Vasan
PHY C105	Practical I (General Physics & Analog Electronics)	C	0	0	3	3	C. Venkateswaran
PHY E101	Probability, Statistics and Error Analysis	E	2	1	0	3	R. Chakrabarti
PHY E102	Physics in Every Day Life	E	2	1	0	3	V. Ravichandran
Semester II							
PHY C106	Mathematical Physics II	C	1	1	0	2	M. Seetharaman
PHY C107	Electromagnetic Theory	C	3	1	0	4	K. Raghunathan
PHY C108	Quantum Mechanics I	C	2	1	0	3	S. S. Vasan
PHY C109	Statistical Physics	C	2	1	0	3	R. Chakrabarti
PHY C110	Practical II (Nuclear Physics & Digital Electronics)	C	0	0	3	3	A. Stephen
PHY E103	Astronomy & Astrophysics	E	2	1	0	3	M. S. Sriram
PHY E104	Materials Science	E	2	1	0	3	A. Narayanasamy, S. Ramasamy, V. Ravichandran
PHY E105	Physics Through Poetry	E	2	1	0	3	P. R. Subramanian
Semester III							
PHY C111	Quantum Mechanics II	C	2	1	0	3	A. S. Vytheeswaran
PHY C112	Condensed Matter Physics I	C	2	1	0	3	V. Ravichandran
PHY C113	Condensed Matter Physics II	C	2	1	0	3	S. Ramasamy
PHY C114	Nuclear Physics & Elementary Particle Physics	C	3	1	0	4	A. Stephen P. R. Subramanian
PHY C115	Numerical Methods	C	1	1	0	2	P. R. Subramanian
PHY C116	Practical III: Computer Programming in C and OOPS	C	0	0	2	2	K. Sivaji
PHY E106	Relativity and Relativistic Quantum Mechanics	E	2	1	0	3	A. S. Vytheeswaran
PHY E107	Resonance Spectroscopy	E	2	1	0	3	S. Ramasamy, V. Ravichandran
PHY E108	Microprocessors & Applications	E	2	1	0	3	K. Sivaji
Semester IV							
PHY C117	Project & Viva–Voce	C	0	0	6	6	All Faculty
PHY E109	Advanced Topics in Mathematical Physics	E	2	1	0	3	K. Raghunathan
PHY E110	Nuclear Reactor Theory	E	2	1	0	3	K. Raghunathan
PHY E111	General Relativity and Cosmology	E	2	1	0	3	K. Raghunathan
PHY E112	Quantum Field Theory	E	2	1	0	3	M. S. Sriram
PHY E113	Advanced Nuclear Theory	E	2	1	0	3	A. S. Vytheeswaran P. R. Subramanian
PHY E114	X–ray Powder Diffraction	E	2	1	0	3	V. Ravichandran
PHY E115	Advanced Materials	E	2	1	0	3	S. Ramasamy, V. Ravichandran, A. Stephen
PHY E116	Microprocessor Laboratory	E	1	0	2	3	K. Sivaji
PHY E117	Accelerator & Nuclear Detectors	E	2	1	0	3	S. Ramasamy
PHY E118	Electronic Communications	E	2	1	0	3	A. Stephen
PHY E119	Magnetism & Magnetic Materials	E	2	1	0	3	Guest Faculty
PHY E120	Biomaterials	E	2	1	0	3	V. Ravichandran

MASTER'S COURSE ABSTRACT

PHY C101	Mathematical Physics I	Core	3	1	0	4	M. Seetharaman

Linear Algebra – Partial Differential Equations – Special Functions – Operational Methods – Complex Variable Theory.

PHY C102	Analog Electronics	Core	2	1	0	3	C. Venkateswaran

Physics of Semiconductor Devices – Negative Conductance Microwave Devices – OpAmps – Linear OpAmp Circuits – on-linear OpAmp Circuits

PHY C103	Digital and Nuclear Electronics	Core	2	1	0	3	K. Sivaji

CMOS Logic Circuits – Counters, Registers and Applications – Memories – D/A and A/D Conversion Techniques and Applications – Nuclear Electronics and Instrumentation.

PHY C104	Classical Mechanics	Core	2	1	0	3	S. S. Vasan

Lagrangian Formulation – Hamiltonian Formulation – Simple Applications – Mechanics of Rigid Bodies – Canonical Transformations.

PHY C105	Practical I (General Physics & Analog Electronics)	Core	0	0	3	3	C. Venkateswaran

Optics & Lasers – Magnetism – Basic Electronic Circuits – Operational Amplifiers – Workshop Practice.

PHY E101	Probability, Statistics and Error Analysis	Elective	2	1	0	3	R. Chakrabarti

Probability – Distributions – Statistics – Error Analysis – Simple Applications.

PHY E102	Physics in Every Day Life	Elective	2	1	0	3	V. Ravichandran

Pre–requisite:

A curiosity to explore Nature and things around us.

Mechanics and Hydraulics – Thermal Physics – Electromagnetism – Optics – Electronics.

PHY C106	Mathematical Physics II	Core	1	1	0	2	M. Seetharaman

Strum–Liouville Theory – One-dimensional Green's Functions – Finite Groups – Simple Applications of Group Theory – Applications of Complex Variable Theory.

PHY C107	Electromagnetic Theory	Core	3	1	0	4	K. Raghunathan

Electrostatics – Magnetostatics – Maxwell's Equations – Electromagnetic Waves & EM Radiation – Wave Guides.

PHY C108	Quantum Mechanics I	Core	2	1	0	3	S. S. Vasan

Basic Formalism – Exactly Solvable Problems in One Dimension – Three-Dimensional Problems – Identical Particles, Spin and Statistics – Angular Momentum Theory – Dirac Notation.

PHY C109	Statistical Physics	**Core**	2	1	0	3	R. Chakrabarti

Thermodynamics – Basic Principles of Statistical Mechanics – Ideal Bose Gas – Ideal Fermi Gas – Applications.

PHY C110	Practical II (Nuclear Physics & Digital Electronics)	Core	1	0	2	3	A. Stephen

Nuclear Physics – Digital Electronics – Spectrochemical Analysis – Solid State Physics – Workshop Practice.

PHY E103	Astronomy and Astrophysics	Elective	2	1	0	3	M. S. Sriram

The Sky and Celestial Sphere – Solar System and Stars – Stellar Models – Galaxies – Cosmology.

PHY E104	Materials Science	Elective	2	1	0	3	A. Narayanasamy S. Ramasamy V. Ravichandran

Structures and Phases of Materials – Metals, Ceramics and Polymers – Composites – Materials for Device Applications – Some Characterisation Techniques.

PHY E105	Physics Through Poetry	Elective	2	1	0	3	P. R. Subramanian

Pre–requisite:

Mathematics and Physics at the Higher Secondary Level & Ability to read, write, and speak Tamil - Numbers, Letters, and Symbols – Dimensional Analysis as the Grammar of Physics (GOP) – Applications of GOP in Higher Mathematics – Particle Physics – An Appreciation of Feynman.

PHY C111	Quantum Mechanics II	Core	2	1	0	3	A.S. Vytheeswaran

General Formalism – Approximation Methods – Time-Evolution Problems – Application to Radiation Problems – Scattering Theory.

PHY C112	Condensed Matter Physics I	Core	2	1	0	3	V. Ravichandran

Nature of Crystalline Solids (Structure, Binding and Defects) – Phonons in Solids – Electrons in Solids – Excitations and Interactions – Interactions with Photons.

PHY C113	Condensed Matter Physics II	Core	2	1	0	3	S. Ramasamy

Dielectrics – Ferroelectrics – Magnetism – Superconductivity – Applications.

PHY C114	Nuclear Physics & Elementary Particle Physics	Core	3	1	0	4	A. Stephen P. R. Subramanian

Nuclear Forces – Nuclear Models – Nuclear Reactions – Beta and Gamma Decays – Elementary Particle Physics.

PHY C115	Numerical Methods	Core	1	1	0	2	P. R. Subramanian

Interpolation and Cubic Splines – Numerical Integration and Numerical Differentiation – Solutions of Algebraic Equations and Differential Equations – Matrices – Curve Fitting.

PHY C116	Practical III Computer Programming C and OOPS	Core Practical	0	0	2	2	K. Sivaji

C and C++ Programming – OOPS – Programs for Numerical Methods.

PHY E106	Relativity & Relativistic Quantum Mechanics	Elective	2	1	0	3	A. S. Vytheeswaran

Relativity – Dirac Equation – Covariant Form and Gamma Matrices – Lorentz Covariance and Bilinear Covariants – Spin and Magnetic Moment.

PHY E107	Resonance Spectroscopy	Elective	2	1	0	3	S. Ramasamy V. Ravichandran

Basics – NMR Spectroscopy – NQR Spectroscopy – ESR Spectroscopy – Mössbauer Spectroscopy.

PHY E108	Microprocessor and Applications	Elective	2	1	0	3	K. Sivaji

Architecture and Programming – Interfacing – Interrupts – Data Communication – Applications.

PHY C117	Project & Viva	Core	0	0	6	6	All Faculty
PHY E109	Advanced Topics in Mathematical Physics	Elective	2	1	0	3	K. Raghunathan

Discrete Groups – Continuous Groups – Special Unitary Groups – Tensors – Tensor Calculus.

PHY E110	Nuclear Reactor Theory	Elective	2	1	0	3	K. Raghunathan

Fundamentals – Thermal Reactors – Neutron Moderation – Homogeneous and Heterogeneous Reactors – Reactor Control and Fusion.

PHY E111	General Relativity and Cosmology	Elective	2	1	0	3	K. Raghunathan

Mathematical Methods and Basis of General Relativity – Field Equations and Exact Solutions – Linearized Equations – Interior Solutions – Cosmology.

PHY E112	Quantum Field Theory	Elective	2	1	0	3	M. S. Sriram

Classical Fields – Quantization of Relativistic Free Fields – Interacting Quantum Fields and Perturbation Theory – Quantum Electrodynamics – Gauge Theories.

PHY E113	Advanced Nuclear Theory	Elective	2	1	0	3	A.S. Vytheeswaran P. R. Subramanian

Elements of Nuclear Astrophysics – The MIT Bag Model – Gauge Theory – Elementary Ideas of Quantum Chromodynamics – Quark–Gluon Plasma.

PHY E114	X–ray Powder Diffraction	Elective	2	1	0	3	V. Ravichandran

Geometry of Crystals – Diffraction – Experimental Powder Crystallography – Analytical Techniques and Applications – Crystal Structure from Powder Data.

PHY E115	Advanced Materials	Elective	2	1	0	3	S. Ramasamy V. Ravichandran A. Stephen

Electronic and Optical Materials – Biomaterials – Magnetic Materials – Superionic and Superconducting Materials – Nanomaterials.

PHY E116	Microprocessor Laboratory	Elective	0	1	2	3	K. Sivaji

Arithmetic and Logic Operations – Interrupts – ADC and DAC – Communications – Applications.

PHY E117	Accelerators & Nuclear Detectors	Elective	2	1	0	3	S. Ramasamy

Different Types of Accelerators – Basic Principles of Operation – Gas Detectors – Scintillation Detectors – Semiconducting Detectors.

PHY E118	Electronic Communications	Elective	2	1	0	3	A. Stephen

Principles of Communication – Wave Guides – Antennas – Microwave Communication – Mobile Communication Techniques.

PHY E119	Magnetism and Magnetic Materials	Elective	2	1	0	3	Guest Faculty

Magnetic Ordering – Magnetic Recording – Spintronics – Recent Novel Magnetic Materials – Magnets Production Technology

PHY E120	Biomaterials	Elective	2	1	0	3	V. Ravichandran

Introduction to Biology and Materials – Biocompatible Materials – Biomimetics – Bio–nanotechnology – Applications to Diagnostics and Pharmacology

M. SC. ELECTRONICS SCIENCE

Subject Code	**Title of the Course**	**C/E**	**Credits**				**Name of the Faculty**
			L	**T**	**P**	**C**	
Semester I							
PHY C201	Mathematical Methods	C	3	1	0	4	P. R. Subramanian
PHY C102	Analog Electronics	C	2	1	0	3	C. Venkateswaran
PHY C103	Digital and Nuclear Electronics	C	2	1	0	3	K. Sivaji
PHY C204	Electronic Instrumentation	C	2	1	0	3	D. Nedumaran
PHY C105	Practical – I Analog & Digital Electronics	C	0	0	3	3	K. Ravichandran
Semester II							
PHY C206	Detectors, Sensors & Transducers	C	3	1	0	4	D. Nedumaran A. Stephen
PHY C207	Microprocessors & Microcontrollers	C	2	1	0	3	S. Ananthi
PHY C208	Electromagnetic Theory & Communications	C	3	1	0	4	R. Chakrabarti S. Ananthi
PHY C209	Quantum Physics & Opto Electronics	C	2	1	0	3	C. Venkateswaran
PHY C210	Practical – II Advanced Experiments	C	0	0	3	3	K. Ravichandran
Semester III							
PHY C211	Industrial Electronics	C	2	1	0	3	K. Ravichandran
PHY C212	PC Architecture and Interfacing	C	2	1	0	3	S. Ananthi
PHY C213	Process Control Instrumentation	C	2	1	0	3	S. Ananthi
PHY C214	Digital Signal Processing	C	2	1	0	3	D. Nedumaran
PHY C215	Practical III - Microprocessor Laboratory	C	0	0	3	3	K. Sivaji, S. Ananthi, D. Nedumaran
PHY E201	Data Communication and Networking	E	2	1	0	3	K Sivaji

Semester IV							
PHY C216	Project and Viva-Voce	C	0	0	6	6	All Faculty
PHY E202	Physics of Electronic Materials	E	2	1	0	3	S. Ramasamy
PHY E203	Principles of Communications Systems	E	2	1	0	3	S. Ananthi
PHY E204	Biomedical Instrumentation	E	2	1	0	3	D. Nedumaran
PHY E205	Nuclear Radiations and Detectors	E	2	1	0	3	S. Ramasamy C. Venkateswaran

PHY C201	Mathematical Methods	Core	3	1	0	4	P.R. Subramanian

Sturm-Liouville Theory – Theory of Complex Variables – Applications of Complex Variables – Laplace Transforms - Fourier Transforms.

PHY C202	Analog Electronics	Core	2	1	0	3	C. Venkateswaran

Physics of Semiconductor Devices – Negative Conductance Microwave Devices – OpAmps– Linear OpAmp Circuits – Non–linear OpAmp Circuits

PHY C203	Digital & Nuclear Electronics	Core	2	1	0	3	K. Sivaji

CMOS Logic Circuits - Counters, Registers and Applications - Memories - D/A and A/D Conversion Techniques and Application - Nuclear Electronics and Instrumentation.

PHY C204	Electronic Instrumentation	Core	2	1	0	3	D. Nedumaran

Principles of Measurement and Testing of Linear Systems – Signal Analysis by Digital techniques – Frequency, Time, Voltage and Current Measurements – Impedance Measurements, Oscilloscopes and Recorders – Trouble Shooting and Maintenance of Equipment.

PHY C205	Practical I - Analog & Digital Electronics	Core	0	0	3	3	K. Ravichandran

Characteristics of Devices - Amplifiers - Oscillators - Op Amps - Digital Circuits.

PHY C206	Detectors, Sensors & Transducers	Core	3	1	0	4	D. Nedumaran A. Stephen

Basic Concepts – Measurement of Displacement, Level and Vibration – Measurement of Pressure, Force and flow – Ionization Detectors & Scintillation Detectors – Semiconductor Detectors.

PHY C207	Microprocessors & Microcontrollers	Core	2	1	0	3	S. Ananthi

The 8085 Microprocessor – Programming 8085 – Programmable Peripheral Chips & Interfacing – Microcontroller (8051) – 8086 Microprocessor

PHY C208	Electromagnetic Theory & Communications	Core	3	1	0	4	R. Chakrabarti S. Ananthi

Electrostatic and Magnetostatic Fields in Matter – Electrodynamics – Electromagnetic Waves, Radiation, Wave Guides – Analog Communication and Digital Communication, PCM, Sampling – Quantization, TDM, Delta Modulation.

PHY C209	Quantum Physics & Opto Electronics	Core	2	1	0	3	C. Venkateswaran

Time Dependent Perturbation Theory – Introduction to Theory & Types of Lasers - Lasers in Optical Storage - Fibre Optic Sensors - Non-Linear Optics.

PHY C210	Advanced Experiments II	Core	0	0	3	3	K. Ravichandran

Digital Storage Oscilloscope (DSO) – DSP (Digital Signal Processing) – Communication Electronics & Optical Fibre Communication – PCB Lab Practice – Radiation Detection.

PHY C211	Industrial Electronics	Core	2	1	0	3	K. Ravichandran

Thyristors – Firing Circuits – Inverters – Choppers – Motor Control.

PHY C212	PC Architecture & Interfacing	Core	3	1	0	3	S. Ananthi

Evolution of Microprocessors – Basic Microcomputer Model – Input Output Interfacing – Interfacing PC for Measurement – PC Configuration and Test.

PHY C213	Process Control Instrumentation	Core	2	1	0	3	S. Ananthi

Linear Open and Closed Loop Process Systems – Stability Response and Advanced Control Strategies – Controller, Processor Identification and Final Control Elements – Sampled Data Control Systems – State, Space, Non-Linear Control and Role of Computers.

PHY C214	Digital Signal Processing	Core	2	1	0	3	D. Nedumaran

Signals & Systems – Fundamentals of DSP – Transform Techniques in DSP – Digital Filter Design – Implementation of DSP techniques in typical DSP Hardware.

PHY C215	Practical III – Microprocessor Laboratory	Core	0	0	3	3	K. Sivaji, S. Ananthi, D. Nedumaran

Software - Hardware - Interfacing - Programming - Interrupts.

PHY E201	Data Communication and Networking	Core	2	1	0	3	K. Sivaji

Data transmission methods – Protocols – Internet standards – Computer networks – Interfaces – Test Techniques and Instrumentation

PHY C216	Project and Viva-Voce	Core	0	0	6	6	Faculty

PHY E202	Physics of Electronicmatrics	Core	0	0	6	6	Faculty

Crystal Lattices & X-Ray Diffraction – Classification of Solids – Electronic Materials – Dielectrics & Ferroelectrics – Magnetic & Optoelectronic Materials.

PHY E203	Principles of Communication Systems	Elective	2	1	0	3	S. Ananthi

Signal and Systems Analysis – Transmission of Signals Through Networks – Information Theory – Pulse Modulation Systems and PCM – Digital Communication.

PHY E204	Biomedical Instrumentation	Elective	2	1	0	3	D. Nedumaran

Suitable for: M. Sc. Electronics Science, Nuclear Physics, Biophysics and Biology students - Electrophysiology and Bio-signal Acquisition – Measurements and monitoring systems – Sensory measurement and nervous systems – Clinical laboratory instrumentation – Biotelemetry and electrical safety.

PHY E205	Nuclear Radiations and Detectors	Elective	2	1	0	3	S. Ramasamy C. Venkateswaran

Interaction of Nuclear Radiation with Matter – Gas Filled Ionization Detectors – Scintillation Detectors – Semiconductor Detectors – Cerenkov, Neutron, Heavy water detectors

M. Phil. THEORETICAL PHYSICS

Course Code	Course title	C/E	Credits				Course Faculty
			L	T	P	T	
FIRST SEMESTER							
PHY C001	Advanced Mathematic Methods for Physicists	C	4	1	0	5	M. Seetharaman, A.S. Vytheeswaran P. R. Subramanian
PHYC002	Advanced Topics in Physics	C	4	1	0	5	M. S. Sriram, A. Narayanasamy S. Ramasamy, V. Ravichandran C. Venkateswaran
PHY E001	Statistical Physics	E	4	1	0	5	R. Chakrabarti
PHY E002	Nonlinear Dynamics and Chaos	E	4	1	0	5	M. S. Sriram
PHY E003	Path Integral Methods	E	4	1	0	5	M. Seetharaman, S. S. Vasan
PHY E004	Atomic Structure	E	4	1	0	5	K. Raghunathan
PHY E005	Quantum Groups	E	4	1	0	5	R. Chakrabarti, S. S. Vasan
SECOND SEMESTER							
PHY C003	Dissertation and Viva-Voce	C	-	-	-	21	Supervisor

M.Phil. NUCLEAR PHYSICS

Course Code	Course title	C/E	Credits				Course Faculty
			L	T	P	T	
FIRST SEMESTER							
PHY C001	Advanced Mathematical Methods for Physicists	C	4	1	0	5	M. Seetharaman, A. S. Vytheeswaran P. R. Subramanian
PHY C002	Advanced Topics in Physics	C	4	1	0	5	M. S. Sriram, A. Narayanasamy S. Ramasamy, V. Ravichandran C. Venkateswaran
PHY E101	Science and Technology of Nanomaterials	E	4	1	0	5	S. Ramasamy
PHY E102	Advanced Materials	E	4	1	0	5	V. Ravichandran
PHY E103	Characterisation of Materials	E	4	1	0	5	Narayanasamy,S. Ramasamy V. Ravichandran,A. Stephen, K Ravichandran
PHY E104	Real Orthogonal Polynomials	E	4	1	0	5	P. R. Subramanian
PHY E105	Advanced Diffraction Techniques	E	4	1	0	5	V. Ravichandran/A. Stephen
SECOND SEMESTER							
PHY C103	Dissertation and Viva-Voce	C	-	-	-	21	Supervisor

M. Phil. SCIENTIFIC INSTRUMENTATION

Course Code	Title of the course	C/E	Credits				Faculty
			L	T	P	C	
First Semester							
PHY C201	Principles of Instrumentation	C	4	1	0	5	D.Nedumaran
PHY C202	Microprocessors and Computing in Instrumentation	C	3	1	1	5	S. Ananthi
PHY E201	Scientific Instrumentation	E	3	2	0	5	S.Ananthi D.Nedumaran
Second Semester							
PHY C203	Dissertation and Viva-Voce	C				21	All Faculty