Post M.Sc. (Biophysical Sciences) 2017-18
Course Structure

1st Term (Aug-Nov)	2nd Term (Dec-Mar)	3rd Term (Apr-Jul)
Basic Course Colloquium Review of Literature	Advance Course Project Research Methodology	Project OGCE

- Basic Courses are compulsory
- A student must choose four Advance Courses from a list of offered courses during Nov/Dec
- OGCE : Oral General Comprehensive Examination

Credit Distribution

Basic Courses	**4 Credit × 4 =**	**16 Credit**
	2 Credit × 2 =	**4 Credit**
Advance Courses	**2 Credit × 4 =**	**8 Credit**
Research Methodology		**8 Credit**
Review & Project		**24 Credit**
Total		**60 Credit**

- A minimum score of 50% is essential in each topic to obtain the credit.
- Evaluation for Basic courses and Research Methodology will be based on continuous assessment and one End-Semester Examination per course.
- Distribution of evaluation weightage: Attendance 10%, continuous assessment 20%, End-Semester Test 70%.

Basic Courses (Compulsory) August-November

1. Biochemistry and Cell Biology (BCB) (40 lectures by Abhijit Chakrabarti, Oishee Chakrabarti, Subrata Banerjee, Chandrima Das**)**

Basic Biochemistry – Biomolecules in water, protein and carbohydrate (complex) solutions, pH, pK, shifts in pK, enzymes, co-enzymes, vitamins, glycolysis, ATP cycle, TCA cycle, oxidative phosphorylation, biosynthesis / degradation of amino acids & proteins, biosynthesis of lipids and carbohydrates, hormone and growth factors.

Cell as unit, identification, characterisation, function of cellular organelles, Golgi, ER, lysozome, mitochondria, cell-membrane, Cell-cell communication, cell-signalling, basics of immune system.

DNA as the Genetic material, Mutations in the genetic material, Mendelian inheritance, Chromosomal inheritance, Eukaryotic genome organization, Gene, Introns, Repetitive DNA seq, Gene duplication and Pseudogenes, Core Histones and Linker histones, Euchromatin vs. Heterochromatin, DNA methylation, Introduction to epigenetics.

Replication, Transcription and Translation.

2. Chemical Biology and Biophysics (CBB) (40 lectures by Montu Hazra, Padmaja Mishra, Debashis Mukhopadhyay and Sangram Bagh).

Definition of life from chemical and physical perspective, Basic thermodynamics, chemical equilibrium of reactions in gas & solution phase chemical reaction dynamics (Introduction to reaction kinetics, complex reaction, Steady-State, equilibrium, chain reaction, catalysis, etc.), and reaction rate theory (Transition State and Collision theory).

Chemical Thermodynamics and its application in Biological Processes (biomolecular recognition, protein folding etc), Use of energy in cellular reactions, Chemical equilibrium and kinetics and its application in biological processes (gene regulation, kinetic proof reading, cancer pathways, enzyme kinetics, biological switch, circadian rhythm), Application of chemical tools in biology.

Diffusion, Osmosis, Osmotic pressure, osmoregulation, surface tension, dialysis, adsorption, viscosity, thermal conduction, colloids, sedimentation.

Introduction to quantum mechanics: Historical development of quantum theory, properties of particles and waves, wave mechanics and applications to simple systems—the particle in a box, the harmonic oscillator, the rigid rotor and the hydrogen atom.

3. Spectroscopy and Nanoscience (SPN) (**20 lectures by** Samita Basu and Dulal Senapati)

Basic Principles of Spectroscopy: Absorption, Emission, and Scattering of light; Excited State Properties; Acidity; Basicity; Polarization; Anisotropy; Solvent Relaxation; Quenching; Energy Transfer, and Electron Transfer.

Nanoscience and Nanotechnology: What is nanoscience and nanomaterials? Historical background of the field nanoscience and nanotechnology; Optical, electrical, and magnetic properties of nanomaterials; different nanomaterials (organic vs. inorganic); common roots of nanomaterials synthesis; Surface modification for specific targeting, Principle of photon therapy, Surface Plasmon Resonance (SPR), Nanomaterials based optics and spectroscopy, applications in sensing, diagnostics, and remediation.

4. Computer Programming & Bioinformatics (CPB) (40 lectures by Gautam Garai and Dhananjay Bhattacharyya**)**

Brief introduction to Bioinformatics and Biological databases, Sequence Alignment (Pair-wise and Multiple), Scoring matrices (BLOSUM62, PAM etc.), Database similarity searching by available tools like FASTA, BLAST etc., Phylogenetic Tree construction; Next Generation Sequencing. Introduction to biological databases.

Perl Programming Language and its application in Bioinformatics.

Molecular modelling software, basic statistics, regression and curve-fitting, some probability and statistical methods (such as Measures of central tendency, probability, probability distributions, Binomial distribution, Normal distribution, Poisson distribution, calculation of errors etc.). Introduction to Computation with Matlab. Matrix handling, plotting, statistical analysis.

5. Macromolecular Structure (MMS) (40 lectures by Rahul Banerjee, Udayaditya Sen/Sampa Biswas, H Raghuraman, Kaushik Sengupta**)**

Nucleic acids, Watson-Crick and non-Watson Crick basepair, DNA double helical and multistranded structures, RNA structural features.

External and internal coordinate system, non-covalent interactions stabilizing biomolecules, amino acids, peptide, proteins, secondary, tertiary, quaternary structure of protein.

Structure determination: Basics of Crystallography, NMR, Site-directed spin labelling and EPR (SDSL-EPR)

6. Radiochemistry & Radiation Physics (RRP) (12 lectures by Susanta Lahiri & **8 lectures** by Maitreyee Nandi**)**

Recapitulation about radioactivity - classification of the nuclides, natural decay chain; Radioactive decay modes - secular and transient equilibrium; Introduction to Nuclear Reactions - Q-values, threshold energy, cross section, excitation functions; Different types of detectors, Nuclear Activation and its applications; Clinical and other applications of radionuclide, radiotracer technique.

Interaction of electromagnetic radiation with matter – Cross-sections –Attenuation and mass energy absorption coefficients

Interaction of charged particles with matter – Classical Theory of inelastic collisions with atomic electrons — Bremmstrahlung –Passage of heavy charged particles through matter –

Range energy relation – Stopping power – Bethe-Bloch formula - Interaction of neutrons with matter – Capture – Neutron, charged particle and photon induced nuclear reactions and their applications

Radiation quantities and units –Particle & Energy flux and fluence–flux and fluence – Interaction of Radiation with Cells, LET – Biological Effects of Radiation, Dosimetry – Energy imparted – Absorbed dose – Kerma-Exposure –Dose equivalent – Charged particle equilibrium (CPE) –Ambient and directional dose equivalents [($H^*(d)$ and $H'(d)$]

Research Methodology (Compulsory) December

i. Biochemical and Molecular Biology Techniques (BMBT) (by Debashis Mukhopadhyay, Partha Saha**)**

Separation techniques: Electrokinetics methods: electrophoresis, electrophoretic mobility (EPM), factors affecting EPM, Paper, PAGE, Capillary, Iso-Electric focusing, applications in biology and medicine. HPLC: mobile phase systems, modes of operations, application, Hydrodynamics method: fundamental principles, Centrifugation, Ultracentrifugation and their applications in molecular weight, size determination. Viscosity and its application.

Technique in molecular biology: DNA detection, RNA detection, Protein detection, cloning, PCR, and related methods.

ii. Spectroscopy and Imaging Techniques (SIT) (by Padmaja Mishra/Kaushik Sengupta, Montu Hazra and H Raghuraman)

Circular dichroism, Infrared spectroscopy including basic principle of FTIR, Raman spectroscopy.

Basic principles of imaging techniques: SEM, TEM, wide-field fluorescence microscopy, confocal scanning microscopy and fluorescence correlation spectroscopy.

iii. Good Laboratory Practices, Radiological safety (Radiation Protection Standards, Principles of Monitoring and Protection), Ethics of scientific research, writing of scientific articles and project proposals.

iv. Research colloquium: During the first week of the course work, presentation on scientific research work carried out in the laboratories where students have opportunity to join for their doctoral work will be made by the respective faculty. Purpose of the colloquiums is to provide an overview of on-going scientific research related to the subject area in the Institute to the new students.

Advance Courses (Optional: to choose four) Dec-March

The list of topics of the offered courses will be given in November 2017.

Review and Project (Compulsory) August-July

Each student chooses one topic from an offered list and carries out an extensive review of literature and experiments with specific scientific aims under the supervision of a faculty. The student submits a dissertation describing the literature survey and reporting the experimental findings which will be evaluated by two faculties. Finally, the student presents and defends the work in an open forum.

Guidelines used to estimate the credits

Basic Course	4 Credit [Classroom Lecture 40; Self Study/tutorial 40; Assignment 20]
	2 Credit [Classroom lecture 20; Self Study/tutorial 20; Assignment 10]
Advance Course	2 Credit [Classroom lecture 20; Self Study/tutorial 20; Assignment 10]
Research methodology	8 credit [Lab Visit 80; Classroom lecture 50; Self Study/Assignment 50; Res Coll. 20]
Review & Project	24 credit [Review 250; Project 300; Report Prep 50]