



**FACULTY COUNCIL OF SCIENCE  
JADAVPUR UNIVERSITY**

**NOTICE**

It is to notify for information of all concerned that the classes of Ph.D. Course Work for the year 2019 under the **Department of Chemistry** will commence from **Monday, the 19<sup>th</sup> of August 2019** in the respective department. All registered candidates who are willing to do Ph.D. course work under the said Department are requested to submit Ph.D. Course registration form duly forwarded by the concerned Supervisor(s) and HoD of the respective Department to the Office of the undersigned within **Wednesday, the 14<sup>th</sup> of August 2019**.

The course work registration form and the modules of course work are appended in the consecutive pages.

**Date: 22/07/2019**

**Sd/-**

**(Dr. Atiskumar Chattopadhyay)  
Principal Secretary,  
Faculty Council of Science**



# যাদবপুর বিশ্ববিদ্যালয়

JADAVPUR UNIVERSITY  
KOLKATA-700 032

FORM FOR COURSE REGISTRATION FOR PH.D.SCHOLARS  
(UNDER F.E.T./F.SC./F.A.)

DEPARTMENT/SCHOOL/INSTITUTION : **CHEMISTRY**  
(in which registered for Ph.D.)

(ENROLMENT FOR SEMESTER: JULY/DECEMBER, JANUARY/JUNE)

1. Name in full (in Block letters) : \_\_\_\_\_
2. Sex(Male/Female) : \_\_\_\_\_
3. Address for Communication: \_\_\_\_\_  
\_\_\_\_\_
4. Phone No. \_\_\_\_\_ Mobile No. \_\_\_\_\_
5. Course Taken:

Sl.No.	Name of Subject/course	Subject Code	Dept./School/Institution under which subject offered
1.	Research Methodology	A	
2.	Review of Research Work	B	
3.			
4.			
5.			
6.			

Date: \_\_\_\_\_

Signature of the student in full

**Head of the Department/Director of School**

**Supervisor(s)**

**Signature of the Dean, Faculty of Science**

Registration No. \_\_\_\_\_ of \_\_\_\_\_

Date of Registration \_\_\_\_\_

Superintendent, Ph.D. Cell, Faculty of Science

# SYLLABUS OF COURSE WORK OF PH.D(Sc.)

## DEPARTMENT OF CHEMISTRY

Courses	Subject	Full Marks
Compulsory Units	A. Research Methodology	50
	B. Review of Research Work	50
Elective Units	I.1. Application of Spectroscopic Studies in Chemical Research	25
	I.2. Materials, Catalyses and Electrochemical Studies.	25
	I.3. Metals in Life and Reaction Dynamics	25
	I.4. Single Crystal X-Ray Structures, Supramolecular Chemistry and DFT Computation.	25
	O.1. Spectroscopy and Asymmetric Synthesis	25
	O.2. Synthesis Methodology	25
	O.3. Advanced Organic Synthesis	25
	O.4. Bio-organic Chemistry	25
	P.1. Theoretical Chemistry	25
	P.2. Chemical and Electrochemical Kinetics and Environment Related Electrochemistry	25
	P.3. Biophysical Chemistry and Surface Chemistry	25
	P.4. Photochemistry and Spectroscopy	25

**N.B. :** Students to opt for **four elective units** out of the elective units offered, in the following manner:-

- i) First unit from any one of I.1., O.1 & P.1;
- ii) Second unit from any one of I.2., O.2 & P.2;
- iii) Third unit from any one of I.3., O.3 & P.3; and
- iv) Fourth unit from any one of I.4., O.4 & P.4.

### Nomenclature of Compulsory Unit:

Illustration: I.2

Abbreviations: I: Inorganic [Similarly O: Organic; P: Physical] & the digit represents Unit No.

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## COMPULSORY UNITS

### A. Research Methodology:

**Definition of problem :** Necessity of defining problem, Technique involved in defining a problem. Surveying the available literature.

**Techniques involved in solving the problem:** Different methods used to solve a problem.

**Research Design:** Subject of study; Place of study; Reason of such study; Type of data required; Method of data collection; Periods of study; Style of data presentation.

**Developing a research plan:** Research objective; Informations required for solving the problem; Each major concept should be defined in operational terms; An overall description of the approach should be given and assumption if considered should be clearly mentioned in research plan; The details of techniques to be adopted.

**Methods of data collection:** Experimental methods.

**Analysis of data:** Various measures of relationship often used in research studies, Correlation coefficients.

**Chi-Square test:** Definition of chi-square test. Significance in Statistical analysis.

### **Computer:**

**Basic of Computer Operating System:** Using Windows – Directory structures – command structure (Document preparation, EXCEL, Power Point Presentation).

**Word Processing:** Basics of Editing and Word processing.

**Numerical analysis.**

**Figure Plotting:** Figure insertions in documents.

**Web Browsing for Research:** Usage of Webs as a tool for scientific literature survey.

**Error Analysis:** Basics of a measurement and its interpretation, mean, standard deviation, variance, correlation coefficient; Usage of packages (e.g. ORIGIN; EXCEL) for data analysis.

**Curve Fitting:** Linear and Non-linear fitting of data.

### B. **Review of Research Work:**

The relevance of the research work from the perspective of the subject – Possible ways to apply the research work in future.

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## ELECTIVE UNITS

### **Unit-I.1: Application of Spectroscopic Studies in Chemical Research**

Advanced treatment of IR and UV-Visible Spectroscopy; Luminescence Spectral Studies; Mass Spectrometry at advanced level; NMR and ESR Spectrometric application; CD and ORD treatment at advanced level.

### **Unit-I.2: Materials, Catalyses and Electrochemical Studies**

Magnetic properties of Materials; Optical properties of Materials; Homogeneous and Heterogeneous catalysis; Sensor; Cations and anions; Thin film semiconductors: synthesis and its application in As and Cd poisoning (as Sensors) as well as solar cells.

### **Unit-I.3: Metals in Life and Reaction Dynamics**

Derivation of complex rate laws and their interpretation; proton ambiguity; how to solve rate laws; how to propose the mechanistic pathways and related matters.

#### Bioinorganic Chemistry

Metalloproteins; metalloenzymes; photosystem; experimental techniques

#### DNA interaction

Interaction of complexes with DNA monitored by (a) UV-Vis spectroscopy; (b) Fluorescence spectroscopy; (c) Cyclic voltammetry and (d) CD.

Environmental health-hazards and remediation; Electrochemical Studies

### **Unit-I.4: Single Crystal X-Ray Structures, Supramolecular Chemistry and DFT Computation**

Crystal growth and data collection; Structure solution and refinement; Supramolecular Chemistry; DFT computation.

### **Unit-O.1: Spectroscopy and Asymmetric Synthesis**

$^1\text{H}$ ,  $^{13}\text{C}$ , 2D & other nuclei; Mass Spectrometry; Asymmetric Synthesis.

### **Unit-O.2: Synthesis Methodology**

Organometallic Chemistry; Green Chemistry; Combinatorial and Carbohydrate Chemistry.

### **Unit-O.3: Advanced Organic Synthesis**

Application of photochemistry and radical chemistry in Organic Synthesis; Pericyclic Reactions; Total synthesis with retro synthetic analysis.

### **Unit-O.4: Bio-organic Chemistry**

Biomimetics; Peptides and Proteins Chemistry; Supramolecular Chemistry.

### **Unit-P.1: Theoretical Chemistry**

#### Basic Quantum Mechanics

A review of Schrödinger formulation; One-dimensional potential barrier problems; Schrödinger, Heisenberg and Interaction problems; Variation and perturbation methods; Time-dependent perturbation; applications.

#### Statistical Mechanics and Computer Simulation

An introductory review of Statistical Mechanics (Real gas, Monatomic Liquids); Introduction to the time correlation function formalism (Absorption of Radiation, Classical theory of light scattering); Computer Simulation Techniques.

#### Irreversible Thermodynamics

Internal heat and entropy production; Relation of entropy production with Fluxes & Forces; Phenomenological equation; Onsager reciprocal relation; Prigogine's principle of minimum entropy production at non equilibrium stationary state.

### **Unit-P.2: Chemical and Electrochemical Kinetics and Environment Related Electrochemistry**

Fuel cells; Solar cells (photochemical, photovoltaic); Batteries (solid-state & conventional)- single electrode and complete cell studies; Production of H<sub>2</sub> and important chemicals of high energy; Corrosion & waste removal techniques.

#### Electrochemical Techniques

Polarography; Chronopotentiometry; Chronoamperometry, Chronocoulometry, Linear Potential Sweep Voltametry; Cyclic Voltametry, Impedance measurements; AC Voltametry.

#### Reaction Dynamics

Factors affecting the chemical reaction rate: temperature, ionic strength of the solution, catalyst, pH and dielectric constant of the medium, micelle, reverse micelle & nanoparticles; Determination of rate constant by stopped flow method & relaxation method; Flash photolysis & use of LASER

### **Unit-P.3: Biophysical Chemistry and Surface Chemistry**

Thermodynamics in Biochemistry (Fundamentals and Applications); Biopolymers (Proteins, Enzymes, DNA, Carbohydrates); Biomembranes (Structure and Function); Active transport and passive transport, Multiple equilibria, Specific examples of multiple equilibria, Transport processes; General features of transport processes; Optical systems for the study of transport processes, Self organizing systems (Micelles, Lipids, Cyclodextrins, Liquid crystals, Reverse micelles, coacervates, Proteins *etc*) their interactions and solutions properties.

Preparation, Characterization and Application of nanoparticles

Surface and Biophysical Techniques: CD, SEM, TEM, EDAX, DLS, Gel Electrophoresis, Radioactivity, XPS.

### **Unit-P.4: Photochemistry and Spectroscopy**

Photon molecule interactions; Absorption, fluorescence and phosphorescence; Quantum yield; Non-radiative deactivations; Excited state; Phosphorescence; Steady state and time resolved aspects; Time-resolved Fluorescence; Flash photolysis; Types of photochemical reactions; Change of properties of molecules upon photo excitation ; Mutagenic effect of radiation; Laser Spectroscopy; Photoelectron Spectroscopy; Mossbauer Spectroscopy; Raman Spectroscopy.

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