

## **Template For Programme Information(Doctoral)**

Doctoral Programmes					
Name of the Programme	Ph.D.				
Scheme of the programme	Ph.D. choice based credit system (CBCS) under adoption of outcome based education system (OBES) / learning outcome curriculum framework (LOCF) W.E.F. 2020-21  CHEM-PhDCW-(I,IIa,IIb,IIc,IIIa,IIIb)				
Syllabus					
<p><b>Structure and Syllabi of</b></p> <p><b>Pre Ph.D Course Work</b></p> <p><b>Under Learning Outcome Curriculum Framework Based</b></p> <p><b>(Effective from the Academic Session 2020-21)</b></p> <p><b>COURSE SCHEME:</b></p> <p><b>Pre Ph.D. Course Work Programme</b></p> <p><b>SYLLABUS</b></p> <p><b>Credits requirement for completion of the Programme: 12</b></p> <p><b>Credits Compulsory Courses: 06</b></p> <p><b>Credits Elective Courses: 04</b></p> <p><b>Credits Seminar: 02</b></p> <p><b>Credits Total: 12</b></p>					
<b>Course Code</b>	<b>Course Title</b>		<b>Credits</b>	<b>Teaching Hours per week</b>	<b>Max. Marks</b>
CHEM- PhDCW-I	Research Methodology	CT	4	4	100
CHEM- PhDCW -IIa	Elective – I	ET	4	4	100
CHEM- PhDCW -IIb	Elective – II	ET	4	4	100
CHEM- PhDCW -IIc	Elective – III	ET	4	4	100

<b>CHEM- PhDCW -IIIa</b>	<b>Research &amp; Publication ethics</b>	<b>CA</b>	<b>2</b>	<b>Assignment Based</b>	<b>50</b>
<b>CHEM- PhDCW -IIIb</b>	<b>Seminar</b>	<b>CS</b>	<b>2</b>	<b>Seminar Based</b>	<b>50</b>
<b>Total Credits/Marks</b>			<b>12</b>		<b>300</b>

**Marks will be converted into letter grade and grade point as per following table:**

<b>Marks</b>	<b>Letter Grade</b>	<b>Grade Point</b>
<b>85-100</b>	<b>O</b>	<b>10</b>
<b>75-84</b>	<b>A<sup>+</sup></b>	<b>9</b>
<b>65-74</b>	<b>A</b>	<b>8</b>
<b>55-64</b>	<b>B<sup>+</sup></b>	<b>7</b>
<b>50-54</b>	<b>B</b>	<b>6</b>
<b>41-49</b>	<b>C</b>	<b>5</b>
<b>40</b>	<b>P</b>	<b>4</b>
<b>Less Than 40</b>	<b>F</b>	<b>0</b>

**Example to calculate the Grade point Average (GPA)**

	<b>Credit</b>	<b>Letter Grade</b>	<b>Grade Point</b>	<b>Credit Point</b>
<b>Paper-I: Research Methodology</b>	<b>4</b>	<b>A</b>	<b>8</b>	<b>4*8=32</b>
<b>Paper-II: Subject Elective : I / II / III</b>	<b>4</b>	<b>A<sup>+</sup></b>	<b>9</b>	<b>4*9=36</b>
<b>Paper-III:</b>	<b>4</b>	<b>B<sup>+</sup></b>	<b>7</b>	<b>4*7=28</b>

<b>Term Paper</b>				
<b>Total</b>	<b>12</b>			<b>96</b>

**A candidate is required to obtain a minimum grade point of 6 in each paper and minimum GPA of 7 to qualify the course work.**

**Pre Ph.D. Course Work  
CHEM-PhDCW-I (Research Methodology)**

**Credits 4  
Max.Mark-100  
Time: 3 hr**

**Note: Attempt any five questions selecting at least one question from each section. Two questions will be set from each section.**

**SECTION-A**

**Scientific Writing:** Scientific document; organization and writing of research paper, short communications, review articles, monographs, technical and survey reports, authored books and edited books and dissertation. Abstract, keywords

**Scientific Methodology:** Meaning, scope, primary sources of literature survey, journals, patents etc. secondary sources of literature survey, books, reference books, text Books, different data base, citation Index, impact Factor, i-10 index and h index

**Chemical Literature:**

- a. The structure of chemical information, important paper based and electronic based sources. How to find chemical information on specific compounds and their syntheses
- b. Abstracts and Journals in Chemistry, electronic forms of Journals, major libraries, subscribing, Journals related to Chemistry in the region and country.
- c. Patents and Patents writing  
Parts of patent applications characteristics of the disclosure for a chemistry invention

**15 hrs**

**SECTION-B**

**Treatment of Experimental Data:** Execution of linear regression, X-Y plot, Programmes with data preferably from physical Chemistry laboratory, Numerical integration and differentiation as well as differential equation solution programmes, Curve fitting by method of least- squares, Word processing software, MS-Excel, Introduction to Networking and search using Internet.

Classification of analytical methods, Types of instrumental analysis, selecting an analytical method, analytical balance, technique of weighing, Selecting and handling of reagent, Safety in analytical laboratory.

**Errors and Evaluation:** Definition of term in mean and median, Precision, standard deviation, relative standard deviation, accuracy, absolute error, relative error, types of error in experimental data. Determinate (systematic), indeterminate (or random) and gross source of errors and effects upon the analytical results. Methods for reporting analytical data, Statistical evaluation of data-in determinate errors, Use of Statistics.

**15 hrs**

### **SECTION-C**

#### **Instrumentation I:**

Metallic Indicators Electrodes, Membranes indicator electrodes, Properties of ion-selective electrode, the glass electrode for pH measurements, crystalline membrane electrodes, liquid membranes electrodes, ISFETS, biocatalytic membrane electrodes

Thermal Techniques; general principles, theory and applications of various thermal techniques; DTA, TG and DSC

Probing bulk and nano structures Scanning Electron Microscopy(SEM), Tunneling Electron Microscopy (TEM)

X ray Diffraction Studies (XRD)

**15 hrs**

### **SECTION-D**

#### **Instrumentation II:**

Theory, instrumentation and applications of various spectroscopic techniques (excluding combined problems): UV, IR, NMR Spectroscopy ( $^1\text{H}$ ,  $^{13}\text{C}$ ) and Mass Spectrometry

**15 hrs**

#### **Books suggested**

1. Practical, Physical Chemistry by Findlay Languages Green and co.Ltd.
2. Analytical Chemistry, G.D. Christian, J. Wiley.

3. Principals of Instrumental Analysis D.A. Skoog, D.M. West & F.J. Holler, T.A. Nieman Saunders College Publishing
4. Analytical Chemistry, Principles, J.H. Kennedy, W B Saunders
5. Analytical Chemistry: Principles & Techniques, L G Hargis, Prentice Hall
6. Vogels Text Book of Practical Organic chemistry, V.S. Furniss et al, Longman group
7. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler and T.C. Morrill.
8. Spectroscopic Methods in Organic Chemistry, D : H Williams and I. Fleming Tata McGraw-Hill.
9. Organic Spectroscopy, William Kemp, John Wiley,
10. How to write and publish a scientific paper, R.A. Day,; Philadelphia, IST Press
11. Scientific and Technical papers, S.F. Tribese, M.I.T. press, Cambridge, Mass and London England
12. Effective writing for Engineers, Managers, Scientists, Tichy, A.L. Wiley, New York and London.
13. Scientific thesis writing and paper presentation by N. Gurumani, MJP Publishers.
14. X-Ray Diffraction Crystallography. Waseda, Yoshino, Matskura, Eiichiro, Shinoda, Koza, Springer.

### **CHEM-PhDCW-IIa (Elective – I)**

**Credits 4**  
**Max.Mark-100**  
**Time: 3 hr**

**Note: Attempt any five questions selecting at least one question from each section. Two questions will be set from each section.**

#### **SECTION-A**

##### **Electroanalytical techniques:**

Basic principle of polarography, Dropping mercury electrode (DME), advantages and disadvantages of DME, cathodic and anodic wave. Different types of current, diffusion controlled wave, Applications of polarography,

Superimposed AC polarography and Square wave polarography.

Amperometric and coulometric titrations: Basic principle and applications.

Cyclic voltammetry: cathodic and anodic stripping voltammetry.

Electrogravimetry: IR Drop, polarization of current and its types. Factors affecting deposition.

**15 hrs**

### **SECTION-B**

#### **Spectroscopic techniques in inorganic analysis:**

Electron spin resonance (ESR), Mossbauer and electronic spectroscopy: Basic principle and applications to determine the structures of inorganic complexes.

**15 hrs**

### **SECTION-C**

#### **Organometallics:**

Synthesis, reactivity and applications of  $\sigma$ -bonded and  $\Pi$ -bonded complexes (organometallics) in catalysis

#### **Supramolecular Chemistry:**

Classification of host-guest compounds, thermodynamics and kinetic stability of supramolecular compounds, different types of macro-molecules hosts, host design, pre-organised hosts cyclodextrin, calixarenes, cryptands and determination of binding constant for supramolecular compounds.

**15 hrs**

### **SECTION-D**

#### **Bioinorganic Chemistry:**

Metalloenzymes: Metalloenzymes of Zinc, Copper and Cobalt- structure, reactivity and biochemical functioning. Medicinal aspects of vit B<sub>12</sub>.

Inorganic compounds as medicine: Lithium drugs in psychiatry, Drugs in hypo and hyper activity of thyroids. Chelation therapy in Alzheimer disease. Vanadium based diabetes drugs.

Bio-sensor:

Theoretical and practical aspects of Clark and enzyme electrode, glucose bio-sensor, cholesterol bio-sensor, glucose bio-sensor based on NAD<sup>+</sup>/NADH, urea bio-sensor, and amino acid sensors.

**15 hrs**

#### **Books Suggested :**

1. The Inorganic Chemistry of Biological Process: M.N. Hughes: John Wiley & Sons.
2. Principles of Bioinorganic Chemistry: S.J. Lippard and J.M. Berg: University Science Books.
3. Principles of polarography: Jaroslav Heyrovsky: academic press.
4. Introduction to polarography and allied techniques: Kamala Zutshi, New age international.

5. Principles of instrumental analysis by Douglas A. Skoog, F. James Holler, Stanley R. Crouch: Cengage Learning.
6. Fundamentals of molecular spectroscopy: C.N. Banwell: McGraw Hills.
7. Textbook of quantitative inorganic analysis: A.I. Vogel ELBS London.
8. Chemical sensors and biosensors: Brian R. Eggins, John wiley and sons, LTD.
9. Chemical sensors and biosensors: Fundamnetal and application: Florinel- Gabriel Banica, John Wiley.
10. Supramolecular Chemistry: Concepts and perspectives: J. M. Lehn, Wiley VCH.
11. Supramolecular Chemistry: Jerry L. Atwood, Jonathan, W. Steed, Wiley 2<sup>nd</sup> edition.

### **CHEM-PhDCW-IIb (Elective – II)**

**Credits 4**  
**Max.Mark-100**  
**Time: 3 hr**

**Note: Attempt any five questions selecting at least one question from each section. Two questions will be set from each section.**

#### **SECTION-A**

The Boltzmann distribution, configurations and weights, relative population of states, molecular partition functions, contributions to partition function, statistical entropy, internal energy, entropy and partition function and other derived functions, contribution to equilibrium constant, applications of statistical thermodynamics to activated complex theory

**15 hrs**

#### **SECTION-B**

Brief account of Thermal analysis techniques, Thermogravimetry (TG) and its application in the study of different materials and composites. Degradation kinetics using different heating rate methods. Differential thermal analysis (DTA), Differential Scanning Calorimetry (DSC) studies and their applications in different components. Evolved gas analysis (EGA) and hyphenated thermal techniques. Different methods for the preparation of nanomaterials, properties and applications of nanomaterials. Synthetic routes of nano composites.

**15 hrs**

#### **SECTION-C**

Recapitulations of polymers and polymerizations, Copolymerization, average molecular weight, molecular weight determination of polymers by Gel Permeation Chromatography, Dendrimers,

Hyperbranched and star polymers, Plasticizers, Polymer composites and its classification, Polymer composites using filler reinforcement, Biocomposites, Applications of biocomposites in automobiles, agriculture and in construction materials, Polymer nanocomposites, Properties and applications of polymer nanocomposites.

**15 hrs**

#### **SECTION-D**

Techniques of approximation, Many electron atoms, coulomb integral, exchange integral, electron correlation, Slater determinants, treatment of hydrogen molecule ion and hydrogen molecule, Self consistent field methods.

Molecular rotations and vibrations, Molecular electronic transitions, selection rules.

**15 hrs**

#### **Books suggested:**

1. An Introduction to Statistical Thermodynamics (Dover Books on Physics) Paperback – 1 January 1987
2. Statistical Thermodynamics by M.C.Gupta,Wiley
3. F.W. Billmeyer, Jr. Textbook of Polymer Science, Wiley- Interscience, N.Y.
4. Introduction to polymer chemistry, R. Seymour, Wiley –Interscience
5. Physical chemistry of Macromolecules, by D.D. Deshpande, Vishal publications,
6. Principles of polymer chemistry by P.J. Flory.
7. Polymer Science by V R Gowarikar,V.R.Viswanathan,Jayadhar Sreedhar; New Age international Publisher
8. Principles of polymerization, G.Odian, Wiley– Interscience Principals of Instrumental Analysis D.A. Skoog, D.M. West & F.J. Holler, T.A.Nieman Saunders College Publishing
9. Introduction to Thermal Analysis Edited by M.E.Brown Springer
10. Polymer Composites, Macro and Micro composites; edited by S.Thomas, K.Joseph, S,K.Malhotra, K. Goda and M.S.Sreekala,Wiley-VCH
11. Quantum Chemistry by Ira N Levine,Pearson

**CHEM-PhDCW-IIc (Elective – III)**

**Credits 4**  
**Max.Mark-100**  
**Time: 3 hr**



**Note: Attempt any five questions selecting at least one question from each section. Two questions will be set from each section**

### **SECTION-A**

#### **Spectroscopic techniques:**

2 D NMR – Principle of COSY, HETCOR, HSQC, DQFCOSY, RL-COSY, DEPT, INEPT, NOESY, HMBC, HMQC, INADEQUATE

Structural elucidation by spectroscopic methods: application of UV, IR and NMR spectroscopy, mass spectrometry in structural analysis of organic compounds. (Combined problems)

Principle of GC-MS, HPLC-MS and GC-FTIR.

### **SECTION-B**

#### **Organic Synthesis:**

Exploitation of various Name reactions/Rearrangements in organic synthesis with special reference to C-C bond formation (Aldol condensation, Benzoin condensation, Perkin reaction, Cannizzaro reaction, Grignard reaction, Diels Alder reaction, Wittig reaction, Friedel Craft Reaction); Coupling reactions (Heck, Sonogashira, Suzuki). Metathesis, Organic Oxidation-Reduction reactions (Wolf Kishner reduction, Birch Reduction, Oppenauer oxidation); Sigmatropic rearrangements (Claisen and Cope rearrangement); C-N rearrangement (Beckman, Hoffmann, Schmidt, Lossen rearrangement)

### **SECTION-C**

#### **Biological and Medicinal Chemistry:**

Brief introduction to microbes: bacteria, fungi, viruses and parasites, Classification of bacteria, Introduction to the terms MIC,  $IC_{50}$ ,  $K_i$ , therapeutic index, LD50 and ED50.

Classification of drugs based on therapeutic action, Elementary idea about drug action: the receptor role, neurotransmitters and receptors, ion channels and their control. Membrane bound enzymes-activation/deactivation. Chemical basis of messenger induced change of shape by the receptor.

### **SECTION-D**

#### **Computer aided drug discovery and quantitative tools:**

The Lead compound, Pharmacophore, Bioinformatics in drug discovery and development, chemical databases, ADME and Toxicity, Virtual Screening, Molecular Docking, Ramachandran Plot, Structure and Ligand Based Drug Designing, Case studies

Introduction to QSAR methodologies and its application in molecular design.

**Note: Candidate will use the latest standard journals/monographs/reviews and books for the study of above course**

**CHEM-PhDCW-IIIa**  
**Research & Publication Ethics: (Assignment Based)**

**Credits: 2**  
**Max. Marks: 50**

Each Candidate shall submit three hard bound copy of a review article on a topic assigned by the proposed supervisor based on published works in one of the following broad fields based on at least 50 relevant up-to-date references for evaluation

(1) Inorganic Chemistry (2) Organic Chemistry (3) Physical Chemistry (4) Pharmaceutical Chemistry  
Candidate will also check the plagiarism by using plagiarism checker and will submit the similarity index (not more than 10%) along with hard bound review. For writing the review student will make use of drawing tools like chemdraw and modern Reference management tools like endnote and mendeley.

**(Page limit Minimum - 15 and maximum-20).**

**CHEM-PhDCW-IIIb**  
**(Seminar)**

**Seminar in thrust area:**

**Credits: 2**  
**Max. Marks: 50**

Each candidate will deliver a seminar on any of the following thrust area along with report before the departmental research committee.

- i) Thermal techniques
- ii) Thermodynamics of liquid mixtures
- iii) Synthetic Organic Chemistry
- iv) Synthetic Inorganic Chemistry
- v) Analytical Chemistry
- vi) Organometalics
- vii) Alkoxides
- viii) Bio-Inorganic Chemistry
- ix) Thermophysical and transport properties

- x) Green Chemistry
  - xi) Heterocyclics
  - xii) Organic Photochemistry
  - xiii) Enzymes Chemistry
  - xiv) Theoretical and Computational Chemistry
- Any other thrust areas(s) duly approved by DRAC

PSO (Programme Specific Outcomes)	None
PEO (Programme Educational Objectives)	None
PO (Programme Outcomes)	None
Time Table	

**Time-Table for Ph.D. Course Work (Online)**  
**Session 2020-21**

Time	12:30 PM-1:30 PM	3:00 PM-4:00 PM			4:00 PM-5:00 PM		
Subject / Days	Research Methodology	Elective-I	Elective-II	Elective-III	Elective-I	Elective-II	Elective-III
Monday	RL / SL		SS	PKS		SS	PKS
Tuesday	SK / RK	RL	GPD	PKJ	RL	GPD	PKJ
Wednesday	SA	AK	SL	NR	AK	SL	NR
Thursday	HA	AC	SA	RK / RKS	AC	SA	RK / RKS
Friday		KS / AK / AC			KS / AK / AC		

Facilities	UV-vis Spectrophotometer, Shimadzu RF-3501 Pc Fluorescence Spectrophotometer, NMR, IR, Cyclic Voltmeter, Rotavapour, Conductivity meter, Tensiometer, Flame photometer, DSA5000, AAS, Sonicator, Centrifugation machine, TGA,
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