

**SARDAR PATEL UNIVERSITY**  
**Semester: I Programme & Subject: M.Phil (Chemistry)**  
**Syllabus with effect from: June 2015**

Course Type	Course Code	Name of Course	Theory/ Practical	Credit	Contact Hrs/Week	Exam Duration in hrs	Component of Marks		
							Internal	External	Total
							Total/ Passing	Total/ Passing	Total/ Passing
Core	PS01CMPH01	Research Methodology-I	Theory	04	3 hrs	3 hrs	30	70	40%
Core	PS01CMPH02	Analytical Methods-I	Theory	04	3 hrs	3 hrs	30	70	40%
Elective (Any Two)	PS01EMPH01	Medicinal Chemistry	Theory	04	3 hrs	3 hrs	30	70	40%
	PS01EMPH02	Coordination Chemistry	Theory	04	3 hrs	3 hrs	30	70	40%
	PS01EMPH03	Chemical Kinetics	Theory	04	3 hrs	3 hrs	30	70	40%
	PS01EMPH04	Forensic Chemistry-I	Theory	04	3 hrs	3 hrs	30	70	40%
Presentation 200 Marks	Practical & Presentation			06				200	50%
Viva 100 Marks	Viva			02				100	50%
<b>Total</b>				<b>24</b>		<b>Total</b>	<b>120</b>	<b>580</b>	<b>700</b>

**Standards of Passing**

**R.PG.Mphil.29** : A candidate shall obtain at least 40% marks on each head at the University examination and 40% in the total of the internal test and the University Examination, and at least 50% marks in dissertation and Viva-Voce examination put together in order to pass the M.Phil. Examination and to be awarded the degree.

# SARDAR PATEL UNIVERSITY

Semester: II Programme & Subject: M.Phil (Chemistry)

Syllabus with effect from: June 2015

Course Type	Course Code	Name of Course	Theory/ Practical	Credit	Contact Hrs/Week	Exam Duration in hrs	Component of Marks		
							Internal	External	Total
							Total/ Passing	Total/ Passing	Total/ Passing
Core	PS02CMPH01	Research Methodology-II	Theory	04	3 hrs	3 hrs	30	70	40%
Core	PS02CMPH02	Analytical Methods-II	Theory	04	3 hrs	3 hrs	30	70	40%
Elective (Any Two)	PS02EMPH01	Heterocyclic Chemistry	Theory	04	3 hrs	3 hrs	30	70	40%
	PS02EMPH02	Bioinorganic Chemistry	Theory	04	3 hrs	3 hrs	30	70	40%
	PS02EMPH03	Advanced Electro Chemistry	Theory	04	3 hrs	3 hrs	30	70	40%
	PS02EMPH04	Forensic Chemistry-II	Theory	04	3 hrs	3 hrs	30	70	40%
Dissertation				06				200	50%
Viva				02				100	50%
<b>Total</b>				<b>24</b>		<b>Total</b>	<b>120</b>	<b>580</b>	<b>700</b>

## Standards of Passing

**R.PG.Mphil.29** : A candidate shall obtain at least 40% marks on each head at the University examination and 40% in the total of the internal test and the University Examination, and at least 50% marks in dissertation and Viva-Voce examination put together in order to pass the M.Phil. Examination and to be awarded the degree.

**SARDAR PATEL UNIVERSITY**  
**Semester: I Programme & Subject: M.Phil (Chemistry)**  
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**Semester: I**

<b>Course Type</b>	<b>Sr.No</b>	<b>Subject Code</b>	<b>Subject Name</b>
Core-I Compulsory	1	PS01CMPH01	Research Methodology-I
Core-II Compulsory	2	PS01CMPH02	Analytical Methods-I
Elective (Any Two)	3	PS01EMPH01	Medicinal Chemistry
	4	PS01EMPH02	Coordination Chemistry
	5	PS01EMPH03	Chemical Kinetics
	6	PS01EMPH04	Forensic Chemistry-I

**Semester: II**

<b>Course Type</b>	<b>Sr.No</b>	<b>Subject Code</b>	<b>Subject Name</b>
Core-I Compulsory	1	PS02CMPH01	Research Methodology-II
Core-II Compulsory	2	PS02CMPH02	Analytical Methods-II
Elective (Any Two)	3	PS02EMPH01	Heterocyclic Chemistry
	4	PS02EMPH02	Bioinorganic Chemistry
	5	PS02EMPH03	Advanced Electro Chemistry
	6	PS02EMPH04	Forensic Chemistry-II

**SARDAR PATEL UNIVERSITY**  
**Semester: I Programme & Subject: M.Phil (Chemistry)**  
**Syllabus with effect from: June 2015**

<b>Paper Code : PS01CMPH01</b>	<b>Total Credit : 04</b>
<b>Title of Paper : Research Methodology-I</b>	

Unit	Description in Detail	Weightage(%)
<b>I</b>	<b>A.The Computer</b> : Its Role in Research – Computer & Computer Technology – Computer System – Important Characteristic – Binary Number System – Applications – Computer & Researchers <b>B.Information technology and library resources</b> : The Internet and World Wide Web, internet resources for chemistry, using spreadsheets, word processors, databases and other packages, finding and citing information (Ref. 6. Chapters 45 to 49 : pages 299 to 321)	<b>25%</b>
<b>II</b>	<b>Unit 2. Fundamental Laboratory Techniques</b> : Basic principles, Health and safety, working with liquids, Basic laboratory procedures I, Basic laboratory procedures II, Principles of solution chemistry, pH and buffer solutions ( Ref. 6. Chapters 1 to 7 : pages 03 to 62)	<b>25%</b>
<b>III</b>	<b>Unit 3. The investigative approach</b> : Making and recording measurements, SI units and their use, Scientific method and design of experiments, Project work (Ref. 6. Chapters 8 to 11: pages 65 to 83)	<b>25%</b>
<b>IV</b>	<b>Unit 4. Analysis and presentation data</b> : Using graphs, Presenting data in tables, Hints for solving numerical problems, Descriptive statistics, choosing and using statistical tests, drawing chemical structures, chemometrics, computational chemistry (Ref. 6. Chapters 37 to 44 : pages 251 to 295)	<b>25%</b>

**Reference Books**

1. Research Methodology, C.R.Kothari, New Age International Publishers, **2004**.
2. Fundamental of Research Methodology and Statistics, Yogesh Kumar Singh, New Age International Publishers, **2006**.
3. Thesis and Assignment Writing, J. Anderson, B.H. Dursten and M. Poole, Wiley Eastern, **1977**.
4. Research Methodology Methods and Techniques, Dr.A.K.Gupta, Vayu Education of India.
5. Research Methodology Text and cases with Spss Applications, Internation Book House Pvt.Ltd.
6. Practical Skills in Chemistry, J. R. Dean, A. M. Jones, D. Holmes, R. Reed, J. Weyers and A Jones, Pearson Education Ltd. [ Prentice Hall] (2002)
7. Tests, Measurements and Research Methods in Behavioural Sciences : A. K.Singh.

<b>Paper Code : PS01CMPH02</b>	<b>Total Credit : 04</b>
<b>Title of Paper : Analytical Methods-I</b>	

<b>Unit</b>	<b>Description in Detail</b>	<b>Weightage(%)</b>
<b>I</b>	UV-Visible Spectroscopy: Electronic transition-chromophores and auxochromes-factors influencing position and intensity of absorption bands-absorption spectra of dienes, polyene and unsaturated carbonyl compounds-woodward Fieser rules –effect of solvent on spectra. IR Spectroscopy: Vibrational frequencies and factors affecting - identification of functional groups – intra and inter molecular hydrogen bonding –finger print region-far IR region.	<b>25%</b>
<b>II</b>	<b>A.</b> H <sup>1</sup> NMR Spectroscopy: H <sup>1</sup> -NMR –introduction – number of signals- chemical shift – factors affecting chemical shifts –multiplicity of signals- coupling constants germinal and vicinal and long range coupling-factors affecting J value –simplification of complex spectra-introduction to FT NMR-pulse techniques- NOE- effect-chemical exchange -H <sup>1</sup> -NMR spectra of some organic and inorganic molecules. C <sup>13</sup> NMR Spectroscopy: Introduction - decoupled and off resonance C <sup>13</sup> NMR Spectra-factors affecting C <sup>13</sup> chemical shifts –empirical calculation of chemical shifts-C <sup>13</sup> NMR Spectra of some organic molecules. <b>B.</b> Introduction to COSY, HSQC, HMBC, NOESY, ROSEY	<b>25%</b>
<b>III</b>	EPR Spectroscopy: Factors affecting the magnitudes of g and A tensors in metal species zero field splitting and Kramer’s degeneracy-spectra of V(II), Mn(II), Fe(II), Co(II), Ni(II) and Cu(II) complexes-Application of EPR to a few biological molecules containing Cu(II), Fe(II) and Fe(III) ions – densities and McConnell relationship-application of EPR to some simple system such as CH <sub>3</sub> , pbenzoquinone and Xe <sub>2</sub> <sup>+</sup> .	<b>25%</b>
<b>IV</b>	<b>Unit 4.</b> Mass Spectroscopy: Principles – Instrumentation – Different ionizing techniques (EI, CI, FD, FAB, MALDI) - Various analysers (Magnetic sector, Quadrupole, Ion trap, ToF) – Analysis of mass spectrum – simple cleavage - β cleavage - allylic cleavage – benzylic cleavage – Factors affecting fragmentation pathways - Mc-Lafferty rearrangement – ortho effect –Fragmentation patterns of common organic compounds.	<b>25%</b>

### References:

1. Banwell C.N. Introduction to Molecular Spectroscopy. TMH Edition, 1994.
2. Barrow G.M. Introduction to Molecular Spectroscopy. McGraw Hill, 1988.
3. Kemp W. Organic spectroscopy. London: ELBS, 2000.
4. Silverstien R.M., and W.P. Weber. Spectrometric identification of organic compounds. 2005.
5. Pavia D.L., G.M. Lapman and G.S. Kriz. Introduction to spectroscopy, 3<sup>rd</sup> Ed. Harcourt College Publishers, 2001.
6. Christian G.D. Analytical chemistry. 5<sup>th</sup> ed, John – Wiley and Sons Inc., 1994.
7. Willard H.H., L.L. Merrit, J.A. Dean and F.A. Set Instrumental methods of analysis. CBS Publishers, 1996.
8. Skoog, West, Holler and Crouch. Fundamentals of analytical chemistry, 8<sup>th</sup> ed. Thomson Asia Pvt. Ltd, 2004.
9. Ahluwalia V.K and M.Goyal. A text book of organic chemistry. New Delhi: Narosa publishing house, 2000.
10. Ahluwalia V.K. and R. Aggarwal. Organic synthesis: special techniques. New Delhi: Narosa pub. house, 2001.
11. Sanghi R. and M.M. Srivatsava. Green chemistry, environment friendly alternatives, New Delhi: Narosa publishing house, 2003.
12. Ahluwalia V.K. and M. Kidwai, New trends in green chemistry, Netherlands: Kluwer academic publishers, 2004.

<b>Paper Code : PS01EMPH01</b>	<b>Total Credit : 04</b>
<b>Title of Paper : Medicinal Chemistry</b>	

<b>Unit</b>	<b>Description in Detail</b>	<b>Weightage(%)</b>
<b>I</b>	<p><b>A. Introduction</b> Development of new drugs, procedures followed in drug design, chemical parameters in drug design (biological isosterism), biological properties of simple functional groups.</p> <p><b>B. Drug discovery, Design and Development</b></p> <p><b>a. Finding a lead:</b> Choosing a disease, choosing a drug target, identifying a bioassay and finding a lead compound.</p> <p><b>b. Optimising target interactions:</b> Structure-activity relationship, identification of a pharmacophore and strategies in drug design.</p> <p><b>c. Drug development:</b> Preclinical and clinical trials, patenting and regulatory affairs, chemical and process development.</p>	<b>25%</b>
<b>II</b>	<p><b>Unit 2. Combinatorial synthesis</b> Solid phase techniques, Methods of parallel synthesis, isolating active component in a mixture: deconvolution, Structural determination, planning and designing a combinatorial synthesis, examples of combinatorial synthesis and its limitations.</p>	<b>25%</b>
<b>III</b>	<p><b>Unit 3. Pharmacodynamics and pharmacokinetics</b> Protein as drug targets: Enzymes- protease, kinase, Protein as drug targets: Receptors- Nuclear receptor, ion channel and GABA receptors Nucleic acids as drug targets</p>	<b>25%</b>
<b>IV</b>	<p><b>Unit 4. Various categories of drugs</b> Antibiotics, Antimalarials, Analgesic &amp; Antipyretics, Anti-inflammatory, Anaesthetics, Tranquilizers, Cardiovascular and Antivirals.</p>	<b>25%</b>

#### References:

1. Silverman R. B. The Organic Chemistry of Drug design and Drug action, Academic press.
2. Lednicer D. Strategies for Organic Drug synthesis and Design. J. Willey.
3. Wilson, Gisvold AND Dorque: Text book of organic medical and pharmaceutical chemistry
4. Graham L.Patrick An introduction to medicinal chemistry, 3<sup>rd</sup> ed, Oxford University press, 2005.

<b>Paper Code : PS01EMPH02</b>	<b>Total Credit : 04</b>
<b>Title of Paper : Coordination Chemistry</b>	

<b>Unit</b>	<b>Description in Detail</b>	<b>Weightage(%)</b>
<b>I</b>	<b>Bonding in Metal Complexes</b> Crystal field theory-splitting of orbitals in octahedral, tetrahedral, square planar, square pyramidal and trigonal bipyramidal fields-Ligand field stabilisation energy-John-Teller effect-Evidence for metal ligand overlap.Molecular orbital theory of transition metal complexes-Molecular orbital energy level diagram for octahedral complexes with and without pi-bonding.	<b>25%</b>
<b>II</b>	<b>Kinetics and Mechanism of metal complex formation</b> Inert and labile complexes-crystal field activation energy-possible mechanisms for ligand replacement reactions Ligand exchange reactions in octahedral complexes of cobalt (III) and Square planar platinum (II), complexes – Trans effect-electron transfer processes. Electron transfer reaction; outer sphere electron transfer, Marcus equation, inner sphere electron transfer- one and two electron transfer reactions, electron transfer through extended bridges, mixed valence compounds, unstable intermediate oxidation state.	<b>25%</b>
<b>III</b>	<b>Electronic spectra of transition metal complexes</b> Charge transfer transition and d-d transition-selection rules and transition probabilities-effect of spin orbit coupling-Spectrochemical series of ligands-Term states for d ions-ergal diagrams-Tanabe-Sugano diagrams-Calculation of Dq. Values with special reference to nickel complexes-Application of uv and visible spectroscopy in the study of metal complexes of first transition series.	<b>25%</b>
<b>IV</b>	<b>A. Magnetic susceptibilities of transition metal complexes</b> Magnetic susceptibility measurements-Gouy Method-Magnetic moment-Orbital contributions to magnetic moment-spin orbit coupling-Temperature independent paramagnetism Application of magnetic moments to structure elucidation. <b>B. Electron paramagnetic resonance</b> Instrumentation and sampling techniques-presentation of the spectrun-hyperfine splitting – Factors affecting the magnitude of g values-Zerofield spllitting and Kramers dageneracy-Nuclear quadrupole interaction-spin hamiltonian – Line widths in solid state EPR-Applications to metal complexes.	<b>25%</b>

## References

- Huheey J.E. Inorganic Chemistry, Principles of Structure and reactivity; New York: Harper and Row,
- F.A Cotton. Applications of group theory New York: Wiley, 1971.
- Cotton F.A. and G.Wilkinson. Advanced Inorganic Chemistry. 4th ed. New York: Wiley Interscience,.
- Basolo F.and R.G.Pearson. Mechanism of Inorganic reactions. New York: Wiley.
- Purcele K.F.and J.C.Kotz. Inorganic Chemistry Philadelphia: W.B. Sonders Company,.
- Drago R.S. Physical Methods in Chemistry. East West Edn.
- Earnshaw A Introduction to Magentic Chemistry. Academic Press.
- Azaroff L.V. Introduction to solids, New York. Mc.Graw Hill.
- Kittel C. Introduction to solid state Physics. New Delhi: Wiley-Eastern.

<b>Paper Code : PS01EMPH03</b>	<b>Total Credit : 04</b>
<b>Title of Paper : Chemical Kinetics</b>	

<b>Unit</b>	<b>Description in Detail</b>	<b>Weightage(%)</b>
<b>I</b>	<b>Introduction to Kinetics</b> Theories of unimolecular reactions, bimolecular reactions, Ter molecular reaction, complex reactions: Reversible, series and parallel reaction, Temperature dependence of rate constants, Arrhenius expression.	<b>25%</b>
<b>II</b>	<b>A.Chain and fast reactions</b> Chain reactions: Straight chain and branched chain reactions. Radical chain reactions, Radical chain polymerization. Potential energy surfaces, Reaction co-ordinate, reaction cross section, Activated complex theory. General methods for studying fast reactions. <b>B.Reactions in Solutions</b> Reactions in solution, primary salt effect, Kinetic isotope effect, solvent isotope effect. Linear Free energy Relationships: Hammett equation, Okamoto-Brown equations. The Taft equation, Swain Scott and Grunwald Winstein equation. Acid base catalysis, Secondary salt Effect, Bronstad Catalysis Law.	<b>25%</b>
<b>III</b>	<b>Kinetics of redox reactions:</b> Outer and inner sphere reactions, kinetics and mechanism of oxidation reactions involving chromium, ruthenium and silver(III). Kinetics of catalyzed reactions: Homogeneous and heterogeneous. Positive, negative and auto catalysed reactions. Induced reactions, promoters and poisons.	<b>25%</b>
<b>IV</b>	<b>Theories of catalysis:</b> intermediate compound formation and adsorption theory, characteristic of catalytic reaction and activation energy of catalyzed reactions. Micellar Catalysis: Models for micellar catalysis( Menger & Portony, Sepulveda, Berezin, Piskiewicz and Raghavan & Srinivasan Models), Phase transfer catalysis, General mechanism, difference between phase transfer and micellar catalysis.	<b>25%</b>

#### References:

1. Gardiner W.C. Rates & Mechanism of Chemical Reactions, W.A. Benjamin Inc. 1969.
2. Gilliam R.D. Introduction of Physical Organic Chemistry. Addison-Wesley, 1969.
3. Moore W.J. and R.G.Pearson Kinetics and Mechanism J.W., New York, 1988.
4. Laidler K.J. Chemical-Kinetics McGraw Hill, New York, 1991.
5. Atkins P.W. Physical Chemistry 16<sup>th</sup> Edn. ELBS, 1998.
6. Chemical Kinetics and Reaction Dynamics by Santosh K. Upadhyay, Anamaya (2008).



<b>Paper Code : PS01EMPH04</b>	<b>Total Credit : 04</b>
<b>Title of Paper : Forensic Chemistry-I</b>	

<b>Unit</b>	<b>Description in Detail</b>	<b>Weightage(%)</b>
<b>I</b>	<p><b>FORENSIC CHEMISTRY</b> : Introduction, types of Cases/ Exhibits, preliminary screening, presumptive test (color &amp; spot test), inorganic analysis, micro-chemical methods for analysis. Examination procedure involving standard method &amp; instrumental techniques, analysis of beverages: alcoholic &amp; non- alcoholic, country made liquor, illicit liquor.</p> <p><b>Arson:</b> Chemistry of Fire, investigation and evaluation of clue material, analysis of arson exhibits by instrumental methods. Management of arson cases.</p> <p><b>Analysis of bribe trap evidence:</b> dyes trap related evidence materialc.</p>	<b>25%</b>
<b>II</b>	<p><b>A. Paint:</b> types of paint and their composition, macroscopic and microscopic studies, pigment distribution, micro-chemical analysis- solubility test, pyrolysis chromatographic techniques, TLC, colorimetry, IR spectroscopy &amp; X-Ray diffraction, elemental analysis, interpretation of paint evidence.</p> <p><b>B. Building materials:</b> Types of cement and their composition, determination of adulterants by physical, chemical and instrumental methods, examination of brick, and analysis of bitumen &amp; road materials, analysis of cement mortar and cement concrete &amp; stones</p>	<b>25%</b>
<b>III</b>	<p><b>A. Forensic toxicology:</b> introduction and concepts of Forensic toxicological examination and its significance.</p> <p><b>B. Poisons-</b> classification of poisoning, collection and preservation of toxicological exhibits in fatal and survival cases, signs and symptoms of poisoning, mode of action and its effect on vital functions, medico-legal and post mortem examination report/finding studies. alysis plan/approach to toxicological examination of poisoning samples. Different types of poisons : Examination of metallic poisons non metallic, animal poison-snake venom, insects bites. plant poisons.</p>	<b>25%</b>
<b>IV</b>	<p><b>Forensic Photography:</b> Basic Principles and Techniques of Black and White and Color Photography, Camera and Lenses, Exposing, Development and Printing, Different types of Developers and Fixers, Modern Development in Photography, Linkage of Cameras and Film Negative, Digital Photography, Digital Water Marking and Digital Imaging, Photogrammetry, Videography, Crime Scene and Laboratory Photography, IR, UV, Photography, Radiography, Portrait Photography, Photomicrography and Microphotography.</p>	<b>25%</b>

## References

- 1) Criminalistics: An Inroduction to Forensic Science – Richard Saferstein.
- 2) Crime Scene Management – M.S.Dahiya.
- 3) Instrumental Methods of Chemical Analysis – Gurdeep R. Chatwal.
- 4) Biophysical Chemistry : Principal & Techniques – Upadhyay. Upadhyay Nath.
- 5) Instrumental methods of Analysis – Willard merritt Dean Settle.
- 6) Physical Chemistry : Principles & Techniques – Upadhyay. Upadhyay Nath.
- 7) Working procedure manual on chemistry (Directorate of Forensic Science).

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<b>Paper Code : PS02CMPH01</b>	<b>Total Credit : 04</b>
<b>Title of Paper : Research Methodology-II</b>	

<b>Unit</b>	<b>Description in Detail</b>	<b>Weightage(%)</b>
<b>I</b>	Survey of literature including patents - chemical nomenclature and literature primary sources - secondary sources including reviews. Treatise and monographs, literature searching, Review of work relevant to the chosen problems. Abstraction of a research paper.	<b>25%</b>
<b>II</b>	Introduction to Internet and its applications – web browsers – World Wide Web – Search Engines – e-journals - literature Survey in Chemistry – Popular journals and websites in Chemistry – Databases in Chemistry - literature searching and collection using e-journals.	<b>25%</b>
<b>III</b>	Writing a thesis or paper - General format - page and chapter formation. The use of quotation - footnotes - tables and figures - referencing - appendixes - revising the paper or thesis – editing and evaluating the final product - proof reading the final typed copy - Publication of Research paper - Presenting in the seminar.	<b>25%</b>
<b>IV</b>	Errors in chemical analysis – classification of errors – determination of accuracy of methods – improving accuracy of analysis – significant figures – mean, standard deviation – comparison of results : “t” test, “f” test and “chi” square test – rejection of results – presentation of data. Sampling – introduction – definitions – theory of sampling – techniques of sampling – statistical criteria of good sampling and required size .	<b>25%</b>

**Reference Books**

1. Research Methodology, C.R.Kothari, New Age International Publishers, **2004**.
2. Fundamental of Research Methodology and Statistics, Yogesh Kumar Singh, New Age International Publishers, **2006**.
3. Thesis and Assignment Writing, J. Anderson, B.H. Dursten and M. Poole, Wiley Eastern, **1977**.
4. Research Methodology Methods and Techniques, Dr.A.K.Gupta, Vayu Education of India.
5. Research Methodology Text and cases with Spss Applications, Internation Book House Pvt.Ltd.
6. Practical Skills in Chemistry, J. R. Dean, A. M. Jones, D. Holmes, R. Reed, J. Weyers and A Jones, Pearson Education Ltd. [ Prentice Hall] (2002)
7. Tests, Measurements and Research Methods in Behavioural Sciences : A. K.Singh.

<b>Paper Code : PS02CMPH02</b>	<b>Total Credit : 04</b>
<b>Title of Paper : Analytical Methods-II</b>	

<b>Unit</b>	<b>Description in Detail</b>	<b>Weightage(%)</b>
<b>I</b>	<b>Analytical techniques :</b> Chromatography- Principles and applications of paper, thin layer, 2D-thin layer chromatography, Gas chromatography-detectors, temperature programming, GC-MS, HPLC Electro analytical methods- Principles and applications of Electrogravimetry, Coulometry, Polarography and Voltammetry, amperometric titrations.	<b>25%</b>
<b>II</b>	<b>A. Thermal methods of analysis. :</b> Theory, instrumentation and applications of TGA, DTA and DSC. Radio analytical methods- neutron activation analysis, isotopic dilution analysis, radiotracer technique. Applications of all these techniques, use of radioactive isotopes in solving analytical and physico chemical problems. <b>B. Capillary electrophoresis:</b> Theory, Instrumentation, Sample separation and detection, applications, capillary electrochromatography, MECC.	<b>25%</b>
<b>III</b>	<b>Analysis of Biomolecules:</b> Enzyme based assay. ELISA, RIA, Fluorescent techniques, Western blotting, Biosensors, and chemosensors. Nano techniques- Detection using fluorescence. DNA sequencing, sequencing of proteins.	<b>25%</b>
<b>IV</b>	<b>Unit 4. New methodologies in organic synthesis</b> <b>Electro-organic synthesis:</b> Special features of electro-organic synthesis as compared to conventional synthesis, reaction variables in electro-organic <b>Synthesis. Classification:</b> synthesis involving cathodic, anodic, phase-transfer catalysed and electropolymerisation reactions, one or two examples of each type of reaction. <b>Biocatalysts in organic synthesis:</b> Introduction, biochemical oxidations and reductions, enzymes catalysed hydrolytic processes. <b>Aqueous phase reactions – Green Chemistry:</b> Diels-Alder reaction, Claisen rearrangement, Michael reaction, aldol condensation, Knoevenagel reaction, benzoin condensation, pinacol coupling, Strecker synthesis, Wurtz reaction, Heck reaction. Oxidations and reductions, polymerization reactions.	<b>25%</b>

### References:

- Banwell C.N. Introduction to Molecular Spectroscopy. TMH Edition, 1994.
- Barrow G.M. Introduction to Molecular Spectroscopy. McGraw Hill, 1988.
- Kemp W. Organic spectroscopy. London: ELBS, 2000.
- Silverstien R.M., and W.P. Weber. Spectrometric identification of organic compounds. 2005.
- Pavia D.L., G.M. Lapman and G.S. Kriz. Introduction to spectroscopy, 3<sup>rd</sup> Ed. Harcourt College Publishers, 2001.
- Christian G.D. Analytical chemistry. 5<sup>th</sup> ed, John – Wiley and Sons Inc., 1994.
- Willard H.H., L.L. Merrit, J.A. Dean and F.A. Set Instrumental methods of analysis. CBS Publishers, 1996.
- Skoog, West, Holler and Crouch. Fundamentals of analytical chemistry, 8<sup>th</sup> ed. Thomson Asia Pvt. Ltd, 2004.
- Ahluwalia V.K and M.Goyal. A text book of organic chemistry. New Delhi: Narosa publishing house, 2000.
- Ahluwalia V.K. and R. Aggarwal. Organic synthesis: special techniques. New Delhi: Narosa publishing house, 2001.
- Sanghi R. and M.M. Srivatsava. Green chemistry, environment friendly alternatives, New Delhi: Narosa publishing house, 2003.
- Ahluwalia V.K. and M. Kidwai, New trends in green chemistry, Netherlands: Kluwer academic publishers, 2004.

<b>Paper Code : PS02EMPH01</b>	<b>Total Credit : 04</b>
<b>Title of Paper : Heterocyclic Chemistry</b>	

<b>Unit</b>	<b>Description in Detail</b>	<b>Weightage(%)</b>
<b>I</b>	<b>A.Introduction</b> Nomenclature, general reactivity patterns of common heterocyclic compounds. <b>B.Small Ring Heterocycles</b> Syntheses of aziranes, oxiranes & thiiranes; Ring openings and heteroatom extrusion; Synthesis & reactions of azetidines, oxetanes & thietanes	<b>25%</b>
<b>II</b>	<b>A. Five membered heterocycles – Furan, Pyrrole and Thiophene</b> Synthesis and reactions <b>B. Six membered heterocycles – Pyridine, Quinoline and Isoquinoline</b> Synthesis and reactions	<b>25%</b>
<b>III</b>	<b>A. Seven-and Large-Membered Heterocycles</b> Synthesis and reactions of azepines, oxepines, thiepinines, diazepines and thiazepines. <b>B. Rings with more than one heteroatom</b> Structural and chemical properties; Synthesis and reactions of 1, 2 –Azoles and 1, 3-Azoles, Synthesis of pyrazole, isothiazole and isooxazole, Synthesis of imidazoles, thiazoles & oxazoles, Synthesis of pyridazines, pyrimidines, pyrazines, Synthesis of triazole and tetrazole.	<b>25%</b>
<b>IV</b>	<b>A. Bicyclic Heterocycles</b> Synthesis and reactions including medicinal applications of benzopyrroles, benzofurans, benzothiophenes, benzimidazoles, benzodiazepines, benzothiazoles, benzoxazoles, quinolines, isoquinolines, benzofused diazines, acridines, phenothiazines, carbazoles and pteridines <b>B.Porphyrins</b> Classification and synthesis of porphin rings; Natural and synthetic metalloporphyrins; importance in biology. <b>C. Biological Heterocycles</b> Chemical and biological properties and total synthesis of thiamine, lysergic acid, reserpine, nicotine, phenanthrene alkaloids, papaverine, nucleic acids bases. Total synthesis of Cephalosporin-C, taxol, Artemisinin, Belladine, Atropine, Heptaphylline, Peepuloidin, Morphine, Camphor, Cadinene, Abietic acid, Gibberelic acid, Zinziberine, Squalene, pelargolidin chloride and Hirsutidin chloride, Azadirachtin.	<b>25%</b>

### Books Suggested:

1. Bansal K. Raj. Heterocyclic chemistry 3rd ed., New Age International (P) Ltd.,1999.
2. Joule J. A. and K. Mills. Heterocyclic chemistry . 4th ed. Blackwell publishing, 2007
4. Gupta R.R., M. Kumar and V. Gupta. Heterocyclic Chemistry Vol. 1-3, Springer Verlag
5. Gilchrist T.L. Heterocyclic Chemistry. Longman Scietific Techinal.
5. Acheson R.M. An introduction to the Heterocyclic Compounds. John Wiley
6. Katritzky A.R. and C.W. Rees. Comprehensive Heterocyclic Chemistry. eds. Pergamon
7. Mann J., R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Natural Products: 18  
Chemistry and Biological Significance, Longman, Essex.
8. Silverman R. B. The Organic Chemistry of Drug design and Drug action, Academic press.
9. Lednicer D. Strategies for Organic Drug synthesis and Design. J. Willey.
10. Wilson, Gisvold AND Dorque: Text book of organic medical and pharmaceutical chemistry
11. Graham L.Patrick An introduction to medicinal chemistry, 3rd ed, Oxford University press, 2005.

<b>Paper Code : PS02EMPH02</b>	<b>Total Credit : 04</b>
<b>Title of Paper : Bioinorganic Chemistry</b>	

<b>Unit</b>	<b>Description in Detail</b>	<b>Weightage(%)</b>
<b>I</b>	<p><b>A.Essential Trace Elements, Alkali metal and alkaline earth cations</b>            Future essential trace elements, role of minerals, essential ultratrace metals and nonmetals.            Coordination chemistry of alkali cations, ligands of alkali cations, ion transport.</p> <p><b>B.Non-redox metalloenzymes</b>            Carboxipeptidase A, carbonic anhydrase, alcohol dehydrogenase.</p> <p><b>C.Redox metalloenzymes</b>            Cytochromes, superoxide and superoxide dismutase, peroxidase and catalase, blue-copper proteins and non-blue proteins.</p>	<b>25%</b>
<b>II</b>	<p><b>A.Respiratory proteins</b>            Myoglobin, haemoglobin, hemerythrin and hemocyanin.</p> <p><b>B.Chemistry of Vitamin B<sub>12</sub> and Model Compounds</b>            Structure of vitamin B<sub>12</sub> , derivatives of vitamin B<sub>12</sub>, properties, Model compounds, chemistry of carbon-cobalt bond, coordination chemistry, photochemistry of vitamin B<sub>12</sub> derivatives, kinetics and ligand exchange.</p>	<b>25%</b>
<b>III</b>	<p><b>A. Iron storage and transport in biological systems</b>            Tranferrin and ferritin</p> <p><b>B.Nitrogen fixation and Iron-Sulphur Protiens</b>            Nitrogenase and rubredoxin.</p>	<b>25%</b>
<b>IV</b>	<p><b>A.Metals in medicine</b>            Chelation therapy, gold compounds and rheumatoid arthritis, anticancer drugs, antimicrobial agents</p> <p><b>B.Effects of Inorganic Pollutants on Biological Systems</b>            Impact of toxic metal ions on enzymes, cadmium, mercury, lead, arsenic, carbon monoxide, nitrogen oxides, sulphur dioxide, cyanide.</p>	<b>25%</b>

## References

1. Hay R.W. Bio-inorganic Chemistry. Chichester: Ellis Horwood Ltd., 1984.
2. Cotton F.A. and G.Wilkinson. Advanced Inorganic Chemistry. 4<sup>th</sup> ed. New York: Wiley Interscience,.
3. Bertini I, H. B. Gray, S. J Lippard and J. S. Valentine. Bioinorganic Chemistry.1<sup>st</sup> ed. Viva Books Pvt Ltd, 2007.
4. Kaim. Wolfgang , Brigitte Schwederski. Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life: An Introduction and Guide. Wiley, 1994.

<b>Paper Code : PS02EMPH03</b>	<b>Total Credit : 04</b>
<b>Title of Paper : Advanced Electro Chemistry</b>	

<b>Unit</b>	<b>Description in Detail</b>	<b>Weightage(%)</b>
<b>I</b>	Fundamental Concepts- Faradaic Processes – Electrical Double Layer - Double-Layer Models - Thickness of the Electric Double Layer - Thermodynamics of Electrochemical Reactions – Standard Potential - Formal Potential - Characteristic Potentials of Electroanalytical Techniques – Thermodynamics of the Transfer of Ions.	<b>25%</b>
<b>II</b>	<b>A.</b> Electrodes: Electrode Materials - Electrode Geometry- Hydrodynamic Conditions- Chemically Modified Electrodes- Microelectrodes - Screen-Printed Electrodes - Cleaning Electrode Surfaces – Electrode Pretreatment - Making Reference Electrodes - Standard Hydrogen Electrode Electrodes of the Second Kind as Reference Electrodes - pH-Based Reference Electrodes - Luggin Capillary – Ion Selective Electrodes. <b>B.</b> Cyclic Voltammetry – Introduction - Basic Principles - Determination of Redox State and Number of Transferred Electrons - Homogeneous Kinetics - Heterogeneous Kinetics – Rotated Disc Electrode - Levich Equation - Ring-Disc Electrode - Rate Constants of Electron Transfer – Tafel Approach to Electrode Kinetics - “Butler-Volmer” Approach - Koutecky-Levich Plot - Measurement of the Reaction Rate.	<b>25%</b>
<b>III</b>	Linear and Sweep Voltammetry - Randles-Sevcik Equation - Effect of Slow Electron Transfer - Semiconducting Electrodes - Quantification of Diffusion Phenomena - Mechanistic Data from Voltammetry - Enzyme-Based Electrodes - Glucose Sensors - Gas Sensors - Carbon Dioxide Sensors - Oxygen Electrodes.	<b>25%</b>
<b>IV</b>	<b>Unit 4.</b> Electrochemical Experimental Set up- Electrochemical Cells - Working Electrode – Reference Electrode - Counter Electrode - Solvents and Supporting Electrolytes - IR Drop – Oxygen Removal - Instrumental Parameters and Wiring - Nonaqueous Media - Elimination of Electrical Noise.	<b>25%</b>

### Reference Books

1. Analytical Electrochemistry, Joseph Wang, Wiley-VCH, **2000**.
2. Fundamentals of Electroanalytical Chemistry, Paul Monk, John Wiley, **2001**.
3. Electroanalytical Methods Guide to Experiments and Applications, (Ed.) Fritz Scholz, Springer, **2010**.
4. Electrochemistry for Chemists, Donald T. Sawyer, Andrzej Sobkowiak, Julian L. Roberts, Jr., John Wiley, **1995**.

<b>Paper Code : PS02EMPH04</b>	<b>Total Credit : 04</b>
<b>Title of Paper : Forensic Chemistry-II</b>	

<b>Unit</b>	<b>Description in Detail</b>	<b>Weightage(%)</b>
<b>I</b>	<p><b>A. Drugs of abuse:</b> Introduction, Classification, drugs of abuse in sports, Narcotic drugs &amp; Psychotropic Substances, Designer drugs &amp; their Forensic Examination.</p> <p><b>B. Forensic Psychology and Investigative Techniques:</b> Forensic Psychiatry (insanity), Criminal Profiling, Polygraph (Lie-Detector), Narco analysis, Brain Fingerprinting</p>	<b>25%</b>
<b>II</b>	<p><b>A. Introduction to fire-arms:</b> History and back ground of firearms, their classification and characteristics, identification of various parts of firearms. various component of small arms, smooth bore and rifled arms, purpose of rifling, types of rifling and methods to produce rifling, cartridge- firing mechanism, improvised/ country made firearms and constructional features.</p> <p><b>B. Introduction to ammunition:</b> Types of ammunition, classification and constructional features of different types of cartridge, types of primers and priming composition, propellants and their composition, various types of bullets and compositional aspects, latest trend in their manufacturing and design, smooth bore firearms projectile, identification of origin, improvised ammunition and safety for handling firearms and ammunition.</p> <p><b>C. Introduction to automated system</b> of trajectory computation and automated management of ballistic data.(BDAS).</p>	<b>25%</b>
<b>III</b>	<p><b>A. Analysis of GSR</b> – mechanism of formation of GSR sources &amp; collection, spot test, Chemical test, Identification of Shooter &amp; Instrumental methods of GSR analysis.</p> <p><b>B. Explosives:</b> classification, composition and characteristics of explosives, pyrotechniques, IEDs, explosion process and affects, types of hazards, effect of blast wave on structures, human etc., specific approach to scene of explosion, post-blast residue collection, evaluation and assessment of scene of explosion, systematic examination of explosives and explosion residue in the laboratory using chemical and instrumental techniques in the laboratory and interpretation of results.</p>	<b>25%</b>
<b>IV</b>	<p><b>A. General and medico legal aspects of injuries-</b> abrasion, bruises, laceration, incised wounds, stab wounds, firearm injuries, defense wounds and fabricated injuries. Regional injuries, traffic accidents, thermal injuries.</p> <p><b>B. Medical legal aspects of death:</b> Death- Definition, Types of death, modes of death. Death from starvation, cold, heat, electricity, Infanticide</p>	<b>25%</b>

### Reference Books

- 1) Forensic Science in Criminal Investigation- B.R.Sharma.
- 2) Narcotic drugs & Substance abuse-Debasis Baghchi.
- 3) Firearms in Criminal Investigations & Trials- B.R.Sharma.
- 4) Principles of Forensic Medicine including Toxicology- Nandi Apurba.
- 5) Parikh's Textbook Medical Jurisprudence Forensic Medicine - C.K.Parikh.
- 6) Forensic Physics Manual (Directorate of Forensic Science).