M.Phil/Ph.D Analytical Chemistry

COURSE OUTLINES FOR M.PHIL. PHD ANALYTICAL CHEMISTRY 2018

PhD/MPhil Analytical Chemistry		
CHM-731	Advanced Research Methodology	3(3 – 0)
CHM-732	Advanced Gas Chromatography	3(3 – 0)
CHM-733	Advanced Liquid Chromatography	3(3 – 0)
CHM-734	Advanced Molecular Spectroscopy	3(3 – 0)
CHM-735	Mass Spectrometric Analysis	3(3 – 0)
CHM-736	Advanced Emission Spectroscopy	3(3 – 0)
CHM-737	Laser and Luminescence Spectroscopy	3(3 – 0)
CHM-738	Analytical Aspects of NMR Spectroscopy	3(3 – 0)
CHM-739	Radiopharmaceutical Analysis	3(3 – 0)
CHM-740	Radio-Analytical Methods of Analysis	3(3 – 0)
CHM-741	Modern Extraction Techniques	3(3 – 0)
CHM-742	Surfaces and Thin Film Analysis	3(3 – 0)
CHM-743	Modern Analysis for Process Industries	3(3 – 0)
CHM-744	Techniques for Polymer Analysis	3(3 – 0)
CHM-745	Environmental Impact of Chemical Industries	3(3 – 0)
CHM-746	X-Ray Methods of Analysis	3(3 – 0)
CHM-747	Advanced Electroanalytical Techniques	3(3 – 0)
CHM-748	Advanced Electrophoretic Techniques	3(3 – 0)
CHM-749	Forensic Chemistry	3(3 – 0)
CHM-750	Automated Methods of Analysis	3(3 – 0)

CHM-731 Advanced Research Methodology 3(3 − 0)

Concept and Philosophy of Research, Research Ethics and Integrity, Quantitative Research and Research Approaches, Quantitative Research Methods, Design of Quantitative Research, Qualitative Research and Research Approaches, Qualitative Research Methods, Data Analysis and Theory in Qualitative Research, Mixed Methods Research, Design of Mixed Methods Research, Evaluation of Mixed Methods Research, Scientific Writing (Report, Article, Dissertation), Use of Modern Aid/Tools for Scientific Writing.

Recommended Books:

1. Dawson, Catherine, 2002. Practical Research Methods, New Delhi, UBS Publishers' Distributors

2. Kothari, C.R., 1985. Research Methodology- Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005. Research Methodology-A Step-by-Step Guide for Beginners, (2nd.ed.), Singapore, Pearson Education.

CHM-732 Advanced Gas Chromatography 3(3 − 0)

History, theory, instrumentation and Applications of Gas Chromatography. Method Development (Selection of column, mobile phase, instrumental considerations, parameter setups), Injection modes in GC, Fused silica capillary GC, Head space GC, Pyrolysis GC, GC-FID, GC-ECD, GC-TCD Sample preparation for GC, Data handling, interpretation, calculation and presentation of results. Hyphenated GC methods and instrumentation: Gas Chromatography-Mass spectrometry, Gas Chromatography-Infrared Spectroscopy, LC-GC, GC-GC, Micro GC. Role of GC in quality assurance in R & D and industries. Supercritical Fluid Chromatography. Introduction, Theory, instrumentation and applications. GC-MS data pre-processing and utilization.

Recommended Books:

1. Scott, R. P. W., 1995. "Techniques and Practices of Chromatography," 2nd Ed., Marcel Dekker, UK.
2. Cassidy, H. G. 1957. "Fundamentals of Chromatography" New York, Interscience Publishers.
3. Gerhard, S. 1990. "Gas Chromatography-A Practical Course" VCH, Germany.
4. Braithwaite, A. and Smith, F.J. 1996. Chromatographic Methods, 5Th eds. Blackie Academic and Professional.

CHM-733 Advanced Liquid Chromatography 3(3 − 0)

History, theory, instrumentation and Applications of Liquid Chromatography in specific area of research. HPLC Method Development (Selection of column, mobile phase, instrumental considerations, parameter setups), Ion Exchange Chromatography, Chromatographic Methods based on Hydrophobicity, Reverse Phase Chromatography, Affinity Chromatography, Size Exclusion Chromatography, FPLC. Chromatography variable effect (band broadening, packed columns efficiency, column impurities, solvent strength and capacity factor, mobile phase and selectivities, UV Cut-Off), Hyphenated LC Methods and Instrumentation: Liquid Chromatography-Mass spectrometry (LC-MS). Role of LC in Quality Assurance and R & D in Industries. Advancement in Chromatography i.e. micro LC, Nano LC, lab on a chip, LC-MS data Pre-Processing and Utilization.

Recommended Books:

1. Scott, R. P. W. 1995. "Techniques and Practices of Chromatography," 2nd Ed., Marcel Dekker, UK.
2. Cassidy, H. G. 1957. "Fundamentals of Chromatography" New York, Interscience Publishers, USA.
3. Snyder, J., Kirkland, J. 1979. "Introduction to Modern Liquid Chromatography", 2nd Ed, Wiley, New York, USA.
4. Braithwaite, A. and Smith, F.J. 1996. "Chromatographic Methods", 5Th eds. Blackie Academic and Professional.

CHM-734 Advanced Molecular Spectroscopy 3(3 − 0)

Overview of Principal and Applications of UV/Visible Spectroscopy; Principle, vibrational modes, absorption frequencies, instrumentation, sample handling and industrial and research

applications of IR Spectroscopy; NMR Spectroscopy: Introduction, basic principle, instrumentation and industrial and research applications. Mass spectrometry: Basic principle, Instrumentation, Modes of fragmentation of various organic molecules, Interpretation of mass spectra. Industrial and research applications. Raman Spectroscopy: Basic theory, Selection rule and comparison with IR, Raman Instrumentation (Dispersive and FT), Applications. Laser spectroscopy: Basic principles and theories, fluorescence spectroscopy and microscopy, two photon and multi photon spectroscopy and microscopy, time resolved infra-red spectroscopy, 2-D IR, Ultrafast spectroscopy, Laser femtochemistry

Books Recommended:

1. Christian, G. D. 2003. Analytical Chemistry. 6th Ed. John Wiley & Sons., New York
2. Harris, B. C. and W. H. Harris. 1991. Quantitative Chemical Analysis. Freeman and Company New York.
3. Skoog, D. A. and D. M. West. 2005. Fundamentals of Analytical Chemistry. Hot Reinhart Inc., London
4. Skoog, D. A. and J. J. Leary, 1992. Principles of Instrumental Analysis. 4th International edition. Harcourt Brace and Company
5. Willard, H. A. and L. L. Merrit. 1997, Instrumental Methods of Analysis. D VanNostrand company Inc., New York.

CHM-735 Mass Spectrometric Analysis 3(3 − 0)

Introduction, Principle and Instrumentation, Ion Sources (EI, CI, ESI, APCI, APPI, FABI, FI, PDI MALDI) with their Areas of Applications, Mass Analyzers (Quadruple, Triple Quadruple, Time of flight, Ion Cyclotron Resonance, Q-ToF) with Specialized Aspects of Applications, Ion Detection (Detectors) and Recording. Fragmentation Pattern of Common Functional Groups of Organic Compounds. Underlying Principles of Modern Analytical Mass Spectrometry Instrumentation and Methods Applied to the Structural Elucidation of Biological Molecules in Conjunction with other Spectroscopic Techniques. Interpretation of Mass Spectrum. Concept and Applications of Tandem Mass Spectrometry,

Recommended Books:

1. Skoog, D. A. and Leary, J.J. 1991. Principles of Instrumental Analysis, 4th eds. Saunders College Publishing.
2. Christian, G.D. 2003. Analytical Chemistry, 6th eds. John Wiley and Sons, New York
3. Kealey, D. and Haines, P.J. 2002. Analytical Chemistry, Bios Scientific Publishers Limited, Oxford, UK.
4. Skoog, D.A., West, D.M. and Holler, F.J. 1997. Fundamentals of Analytical Chemistry, Harcourt College Publishers
5. Robert, M. Silverstein, G. Clayton Bassler and Terence, C. Morrill. 1981. Spectrometric Identification of Organic Compounds. John Wiley and Sons. New York, USA.

CHM-736 Advanced Emission Spectroscopy 3(3 − 0)

Introduction, Principles and Instrumentation of Plasma Emission Spectroscopy. Production of Plasma by Various Methods (Inductively Coupled Plasma, Direct Current Plasma, Microwave Induced Plasma), Principle, Instrumentation and Applications of ICP, DCP based AES in Various Research Fields, Arc and Spark based Emission Spectroscopy and their Industrial Applications.

Recommended Books:

1. Thomspon, K. C., Reynold, R. J. 1978. “Atomic Absorption, Fluorescence and Flame Emission Spectroscopy” 2nd Ed. John Wiley and Sons, USA.
2. Fisher, A., Hill, H. J., Ebdon, Evans, E. H. 1998. “An Introduction to Analytical Atomic Spectrometry" Wiley, Chichester, USA.
3. Dowden, Hutchinson, Ross, 1976. “Emission Spectroscopy”, Barnes, R. M. (Ed.,) Stroudsburg, Pa:Dowden, Hutchinson & Rose New York, USA.

CHM-737 Laser and Luminescence Spectroscopy 3(3 − 0)

Introduction, Principle, Laser Operation, Spontaneous Emission Mission, Stimulated Emission, Population Inversion, Population Inversion in two level system, three level system in four level system. Properties of laser light. Types of lasers; Nitrogen laser, CO_2 laser, Ruby laser, Dye laser. Uses of lasers. Radiation in Fluorescence Spectroscopic Methods. Applications. Laser Induced Chemical Reactions, Laser in Industrial Chemical Processes. Luminescence and its types, Theory of Fluorescence and Phosphorescence, Deactivation Processes, Atomic and Molecular Fluorescence Spectroscopy, Principle and Instrumentation and Application of Fluorescence and Phosphorescence Spectroscopy.

Recommended Books:

1. Stenholm, S. 2008. “Foundations of laser spectroscopy”, John Wiley and Sons Inc., 605 Third Avenue, New York, USA.
2. Demtroder, W. 2003. “Laser Spectroscopy: Basic Concepts and Instrumentation, 3rd Ed., Springer-Verlag Berlin Heidelberg New York, USA.
3. Cremers, D. A., Radziemski, J. L. 2006. “Handbook of Laser-Induced Breakdown Spectroscopy”, John Wiley & Sons, USA.
4. Ronda, C. 2008. “Luminescence”, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim. Germany.
5. Valeur, B. 2002 “Molecular Fluorescence, Principle and Application” Wiley-VCH, Weinheim, Germany.
6. Ebdon, E. H. Evans (ed.), A. Fisher and S.J. Hill. 1998. “An Introduction to Analytical Atomic Spectrometry” Wiley, Chichester, USA.

CHM-738 Analytical Aspects of NMR Spectroscopy 3(3 − 0)

Theory and Principle of NMR, Concept of Nuclear Spin and Magnetism, Energy levels and NMR spectra, the vector model for NMR, Free induction decay, Fourier transform and data processing, T1, T2 Relaxation, NMR Spectrometer instrument, Sample preparation, Solvent selection, Volume and concentration considerations, Spectrometer Setup, Deuterium lock, Probe tuning. Optimizing the signal, Sample tube placement, Probe adjustment, Field and frequency lock, Spectrometer shimming. Determination of NMR Spectra: Data Acquisition, Number of data pints, Spectral width, Filter band width, Acquisition time, Transmitter offset, Flip angles, Receiver gain, Number of scans, Steady state scans, Oversampling and digital filtration, Decoupling for X nuclei, Excitation Modes, Inverse Detection. Data Processing: Spectral assignments, Signal-to-Noise Enhancement, Resolution Enhancement, Phasing, Baseline Corrections, Peak Picking and Integration. Model 1D and 2D homo and hetronuclear NMR experiments, Relaxation time measurements, Solvent suppression techniques. NMR applications in various fields of industry and research

Recommended Books

1. Keeler, J. 2010, Understanding NMR Spectroscopy, John Wiley & Sons. Inc.

2. Lambert, J. B., Mazolla, E. P. "Nuclear Magnetic Resonance Spectroscopy: An Introduction to Principles, Applications, and Experimental Methods" Pearson Prentice Hall Education Inc. New Jersey, USA.
3. Jacobsen, N. E. 2007. "NMR Spectroscopy Explained", Wiley Interscience, John Wiley & Sons Inc. Hoboken, New Jersey USA.
4. Mitchell, T. N., Costisella, B. 2007. "NMR-From Spectra to Structure" 2nd Ed. Springer Verlag, Berlin Germany.
5. Levitt, M. H. "Spin Dynamics-Basics of NMR" 2nd Ed. John Wiley & Sons Inc.

CHM-739 Radiopharmaceutical Analysis 3(3 − 0)

Introduction to radiopharmaceuticals, Theory and production of radionuclides, decay modes of radionuclides, Radionuclide separation techniques and generators, Diagnostic and therapeutic radionuclides, specific activity, Mass-activity relationship, Radiolabeling strategies and mechanism, Physicochemical aspects of the preparation of 99mTc-labeled radiopharmaceuticals, Quality control of radiopharmaceuticals, Radiopharmaceutical analysis using chromatographic and electrophoretic techniques, In-vitro and in-vivo evaluation of radiopharmaceuticals using biodistribution and SPECT/PET scintigraphic techniques.

Books Recommended:

1. Gordon, Breach, 1999. "Textbook of Radiopharmacy, Theory and Practice" 3rd Ed, Science Publishers, Netherland.
2. Prekeges, Jennifer, 2004. "Nuclear Medicine Instrumentation" 1st Ed, Society of Nuclear Medicine, New York, USA.
3. Gunderson, L. L. Tepper, 2007. "Clinical Radiation Oncology" 2nd Ed. Elsevier, Netherland.

CHM-740 Radio-Analytical Methods of Analysis 3(3 − 0)

Introduction; Structure of atom and nucleus; Radioactive decay; Unit of radioactivity; Cyclotron and Reactor based radionuclides; Instruments for radiation detection and measurement; Nuclear reactions, radiochemical decay and activity, Sample handling and safety, statistical considerations during measurements, background corrections, radiochemical analysis; activation analysis, Neutron and proton activation analysis (NAA & PAA), qualitative and quantitative NAA, Radiometric titrations, Gamma ray spectroscopy, Proton induced X-ray emission spectroscopy. Applications of radio-analytical techniques in environment, medical, industry, forensic and archaeological field.

Recommended Books:

1. Robert D. Braun, 1996. Introduction to Instrumental Analysis by international student edition.
2. Gary D. Christian, 1994. Analytical Chemistry, Fifth edition, New york.
3. Robert D. Braun 1998. Introduction to Chemical Analysis; international student edition.
4. Jack Cazes, 2000. Ewing's Analytical Instrumentation Handbook by third edition.
5. Douglas A. Skoog, F. James Holler and Stanley R. Crouch, 1992. Principles of Instrumental Analysis by, sixth edition.

CHM-741 Modern Extraction Techniques 3(3 − 0)

Overview of Extraction Techniques for Medicinal and Aromatic Plants; Extraction, Isolation of Chemical Constituents from Plant Sources Leading to Pure Compounds; Role of Process Simulation to Extraction Technologies for Medicinal Plants, Maceration, Hydrolytic Maceration, Percolation, Expression and Infusion Techniques; Distillation Technologies For Essential Oils Including Microwave Assisted Hydro-Distillations; Solid Phase Micro-Extraction and Headspace Trapping Extraction, Supercritical Fluid Extraction of Medicinal Plants, Fundamentals and Applications of Flash Chromatography and Counter-Current Chromatography.

Books Recommended

1. Handa, S.S., Khanuja, S.P.S., Longo, G. & Rakesh, D.D. 2006. Extraction technologies for medicinal and aromatic plants. International Centre for Science and High Technology Trieste, Italy.
2. FereidonShahidi (1996). Natural antioxidants: Chemistry, health effects, and applications. AOCS Press, IL, USA.
3. DebasisBagchi, Francis C. Lau, Dilip K. Ghosh (2010). Biotechnology in Functional Foods and Nutraceuticals. CRC press Taylor and Francis Groups, UK
4.

CHM-742 Surfaces and Thin Film Analysis 3(3-0)

Learning Objectives:

The course will familiarize the students from the basic to advance trends in the field of surfaces and thin film analysis techniques. The course includes introduction to the instrumentation, theory, design, and operation to critically analyse the surface chemistry with available modern techniques. It will capitalize the students to use the knowledge in microelectronics, soils, catalysis, composites and environment sciences.

Course Contents:

Fundamental and applied aspects of solid/liquid surfaces and interfaces including metals, oxides, polymers, microbes, water and other materials. Their structure modifications, thermodynamics and mechanical properties. Surfaces and interface characterization by x-ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES), secondary ion mass spectroscopy (SIMS), and Rutherford backscattering spectroscopy (RBS). Theory/Principle and instrumentation Comparison & differences in surface sensitivity, spatial resolution, etc.; and the cost and ease of obtaining the informations.

Applications included microelectronics, soils, catalysis, composites and environment.

Books Recommended:

1. J. C. Vickerman, I. Gilmore, “Surface Analysis, the Principle techniques”, 2nd Ed, John Wiley and Sons, New York, USA (2009).
2. D. J. O’ Connor, B. A. Sexton, “Surface Analysis Methods in Material Science”, Volume 23, 2nd Ed, USA (2003).
3. John C. Vickerman, Ian Gilmore (editors), "Surface Analysis: The Principal Techniques", Wiley, New York, 2009 (second edition)
4. John F. Watts, John Wolstenholme, "An Introduction to Surface Analysis by XPS and AES", Wiley, New York, 2003 (second edition)
5. John C. Rivière, Sverre Myhra (editors), "Handbook of Surface and Interface Analysis: Methods for Problem-Solving", CRC Press, Boca Raton, 1998
6. C. Richard Brundle, Charles A. Evans, Shaun Wilson, "Encyclopedia of Materials Characterization: Surfaces, Interfaces, Thin Films", Butterworth-Heinemann, Stoneham, 1992

7. Gernot Friedbacher, Henning Bubert (editors), "Surface and Thin Film Analysis: A Compendium of Principles, Instrumentation, and Applications", Wiley-VCH, Berlin, 2011

CHM-743 Modern Analysis for Process Industries 3(3 − 0)

Introduction to Instrumental Analysis, History and Importance in Industrial Growth, Selection of Analytical Method for Analysis.

Chromatographic Methods of Analysis: (GC, HPLC, SCFC); Principle and their Applications with Special Emphasis on Industrial Product Evaluation

Spectroscopic Methods of Analysis: (FTIR, MS, NMR, AAS and AES) Basic Principle and their Qualitative and Quantitative Applications in Industrial Sector

Thermal Method of Analysis: (TGA, DTA and DSC) Basic Principles and Applications with Special Emphasis for Characterization of Polymeric Materials

Books Recommended

1 Khopkar, S.M. 2008. Basic Concepts of Analytical Chemistry, New Age International Publishers, New Delhi, India
2. Christian, G.D. 2003. Analytical Chemistry. Sixth edition, John Wiley and Sons, New York
3. Kealey, D. and P.J.Haines, 2002. Analytical Chemistry, Bios Scientific Publishers Limited, Oxford, UK
4. Skoog, D.A. and J.J. Leary. 1992. "Principles of Instrumental Analysis. Saunders College Publishing Co., London
5. Sharma, B.K. 2005. Instrumental Methods of Chemical Analysis, Goel Publishing House, Meerut, India

CHM-744 Techniques for Polymer Analysis 3(3 − 0)

Introduction to Polymers, Properties of Macromolecules/Polymeric Materials, Characterization of Polymers by IR, FTIR and ATR-FTIR, Chromatographic Methods for Polymer Separations and Analysis, Size Exclusion Chromatography (SEC), Gel Permeation Chromatography (GPC), Two-Dimensional Liquid Chromatography, Hyphenated Techniques; LC/MS, LC-FTIR for Polymer Analysis, Thermal Analysis of Polymers by TGA, DTA, DSC and EGA.

Recommended Books:

1. T. Provder, H. G. Barth, M. W. Urban, "Chromatographic Characterization of Polymer, Hyphenated and Multidimensional Techniques", American Chemical Society, Washington DC, USA (1995).
2. Snyder, J. J. Kirkland," Introduction to Modern Liquid Chromatography", 2nd Ed, Wiley, New York, USA (1979).
3. Stock, Rice, "Chromatographic methods," 2nd Ed, Chapman and Hall, UK (1967).
4. R. P. W. Scott, "Techniques and Practices of Chromatography," 2nd Ed, Marcel Dekker, UK (1995).

CHM-745 Environmental Issues of Chemical Industries 3(3−0)

Concept of Environmental Issues of Chemical Industries, Environmental Concerns and Legislation

Regarding Air, Water and Particulate Pollution and WTO Challenges, Industrial Pollution as Life Threat to Mankind, Conventional, Physical, Chemical, Biological and Biochemical Approaches

to Mitigate Industrial Pollution with their Merits and Demerits, Bioremediation and Biodegradation Methods for Advanced Water Research.

Books Recommended

5. Christie, R. M., 2006. Environmental Aspects of textile dyeing, R. M. Wood head publishing in Textiles, Belgium.
6. Zee, F. P. Vander, 2002. Aerobic azo dye reduction. CIP-Data Koninklijke Bibliotheek, Den Haag.

CHM-746 X-Ray Methods of Analysis 3(3 − 0)

History, principles, X-ray wavelength and energy scales, spectral lines, X-Ray tubes, Interaction of X-rays with matter, The photoelectric effect, X-ray emission, absorption, fluorescence and diffraction methods, X-Ray absorption spectroscopy, instrumentation, sources of X-Rays, detectors, chemical analysis by X-Ray absorption spectroscopy, XRF spectroscopy, Instrumentation, Wavelength-dispersive XRF, Total reflection XRF, Microscopic XRF, Qualitative, Quantitative analysis, XRD instrumentation, The Laue method, powder diffraction method, rotating crystal method, XAS instrumentation, Compositional analysis of historic Glass, pigments, lustre ware, metallic artefacts, analysis of graphic documents, role of X-ray methods in the modern analytical laboratory, continuous and characteristic radiation, selection rules, role of crystal structure in X-ray scattering and diffraction, interference and diffraction effects

Recommended Books:

1. R. Van Grieken and A. Markowicz (2002.), Handbook of X-ray Spectrometry, 2nd ed., Marcel Dekker, New York.
2. Douglas A. Skoog, F. James Holler and Stanley R. Crouch (2007). Principles of Instrumental Analysis, sixth edition.
3. Cullity and Stock. (2001). General text on X-ray diffraction: Elements of X-Ray Diffraction (3rd Edition) ISBN: 0201610914

CHM-747 Advanced Electro-Analytical Techniques 3(3 − 0)

Introduction to Electroanalytical methods, classification. Potentiometry. Nernst equation, standard potential, Reference and indicator electrods, pH meter, pH electrodes. Ion Selective Electrodes - construction of ISEs, solid and liquid membranes, ion, gas-sensing and enzyme ISEs, applications of ISEs, Biosensors.

Polarography and voltammetry. Introduction, instrumentations and general techniques, current-potential characteristics, Ilkovic equation, Qualitative and quantitative analysis. normal pulse and differential pulse polarography and voltammetry. Cyclic voltammetry. Anodic, cathodic and adsorptive stripping voltammetry. Hydrodynamic electrodes and microelectrodes. Electroanalysis using modern electrochemical methods: Quartz Crystal Microbalance QCM, Scanning Tunneling Microscopy (STM), Atomic Force Microscopy (AFM). Scanning electrochemical microscopy (SECM). Electrochemical responses in macro- and microelectrodes: Fundamentals of electrochemical microscopy. SECM operating modes. Amperometric feedback responses: positive and negative feedback. Sweep mode: obtaining images. Application in specific area of research.

Recommended Books:

4. C.G. Zoski,2007. Handbook of Electrochemistry, Elsevier, Amsterdam.
5. V. S. Bagotsky, 2006. Fundamentals of Electrochemistry, Wiley-Interscience, Hoboken New Jersey.

6. A.J. Bard and L.R. Faulkner, 2000. Electrochemical Methods, Wiley-Interscience, Hoboken New Jersey.
7. C.M.A. Brett and A.M.O. Brett, 2003. Electrochemistry. Principles, methods and applications, Oxford Science Publications.

CHM-748 Advanced Electrophoretic Techniques 3(3 − 0)

Introduction to electrophoresis, Classification of electrophoresis; Principle and analytical applications of zone electrophoresis, gel electrophoresis (special emphasis on Poly Acryl amide and Agarose gel electrophoresis), isoelectric focusing electrophoresis, capillary electrophoresis, serum protein electrophoresis and immune-electrophoresis; Electrophoretic support media; Effect of experimental conditions on electrophoretic separations; Electric field strength gradient; Chemical, biochemical and instrumental methods of detection; Principle and applications of capillary electrophoresis hyphenated with mass spectrometry (CE-MS).

Books Recommended:

1. L. A. Lewis, CRC 1980. Handbook of Electrophoresis, CRC Press, Boca Raton, FL.
2. R. Westermeier, 2001. Electrophoresis in Practice, Wiley-VCH, New York,
3.J. Breborowicz and A. Mackiewicz, 1991. Affinity Electrophoresis: Principles and Applications, CRC Press, Boca Raton, FL
4. P. G. Righetti, 1983. Isoelectric Focussing: Theory, Methodology and Applications, Elsevier, New York.
5. D. Schmalzing, S. Buonocore, and C. Piggee, 2000. Capillary Electrophoresis-Based Immunoassays, Electrophoresis 21, 3919–3930.
6. C. Horvath and J. F. Nikelly, 1990. Eds., Analytical Biotechnology: Capillary Electrophoresis and Chromatography, American Chemical Society, Washington, DC.

CHM-749 Forensic Analysis 3(3 − 0)

Introduction and Scope of Forensic Science; Crime Scene Investigation; Protecting the Evidence, Trace Evidence Examination, Biological Evidence (Blood Splatter Studies) and Physical Evidence (Fire Arms and Tool marks); Testing of Evidences for Criminal Investigations; Fingerprint analysis, Sample Collection, Storage, Preparation and Analysis of Various types of Evidences Using State-of-The-Art Analytical Instruments; Interpretation of Analytical Data; Good Laboratory Practices, Quality Assurance and Quality Control; Method Validation; Chemo-Metrics in Interpretation of Scene of Crime with Chemical Evidence, Role and Responsibilities of Analytical Chemist as Forensic Scientist.

Books Recommended:

1. Stuart H. James, Jon J. Nordby (2009). Forensic Science: An Introduction to Scientific and Investigative Techniques, 3rd eds. CRC Publisher.
2. Richard Saferstein (2003). Criminalistics: An Introduction to Forensic Science, 8th edition, Prentice Hall College.
3. Skoog, D. A. and Leary, J.J. 1991. Principles of Instrumental Analysis, 4th eds. Saunders College Publishing.
4. Boyer, R. 2009. Modern Experimental Biochemistry 3rd edition.Dorling Kindersley (India) Pvt. Ltd.
5. Kealey, D. and Haines, P.J. 2002. Analytical Chemistry, Bios Scientific Publishers Limited, Oxford, UK.
6. Skoog, D.A., West, D.M. and Holler, F.J. 1997. Fundamentals of Analytical Chemistry, 7th eds. Harcourt College Publishers

CHM-750 Automated Methods of Analysis 3(3 − 0)

Overview of Automatic Instruments and Automation, Automated Laboratory Analysis, Unit Operations in Chemical Analysis, Flow Injection Analysis, Discrete Sample Analyzers, Centrifugal Fast Scan Analyzers, Automated Titrators, Process Control, Process Control Analyzers. Automatic Titrator, Automation in Clinical Chemistry, Automation in Environmental Pollution Monitoring, Automation in Analytical Techniques like Electro-Analytical Techniques and Chromatographic Techniques and their Applications in Industrial Process Control and Research.

Books Recommended:

1. Skoog, D. A. and Leary, J.J. 1991. Principles of Instrumental Analysis, 4th eds. Saunders College Publishing.
2. Braithwaite, A. and Smith, F.J. 1996. Chromatographic Methods, 5Th eds. Blackie Academic and Professional.
3. Kealey, D. and Haines, P.J. 2002. Analytical Chemistry, Bios Scientific Publishers Limited, Oxford, UK.
4. Skoog, D.A., West, D.M. and Holler, F.J. 1997. Fundamentals of Analytical Chemistry, 7th eds. Harcourt College Publishers