JAI HIND COLLEGE
BASANTSING INSTITUTE OF SCIENCE
&
J.T.LALVANI COLLEGE OF COMMERCE
(AUTONOMOUS)

"A" Road, Churchgate, Mumbai - 400 020, India.

Affiliated to
University of Mumbai

Affiliated to
University of Mumbai

Program: M.Sc. in Chemistry

Course: Analytical Chemistry I

Semester I

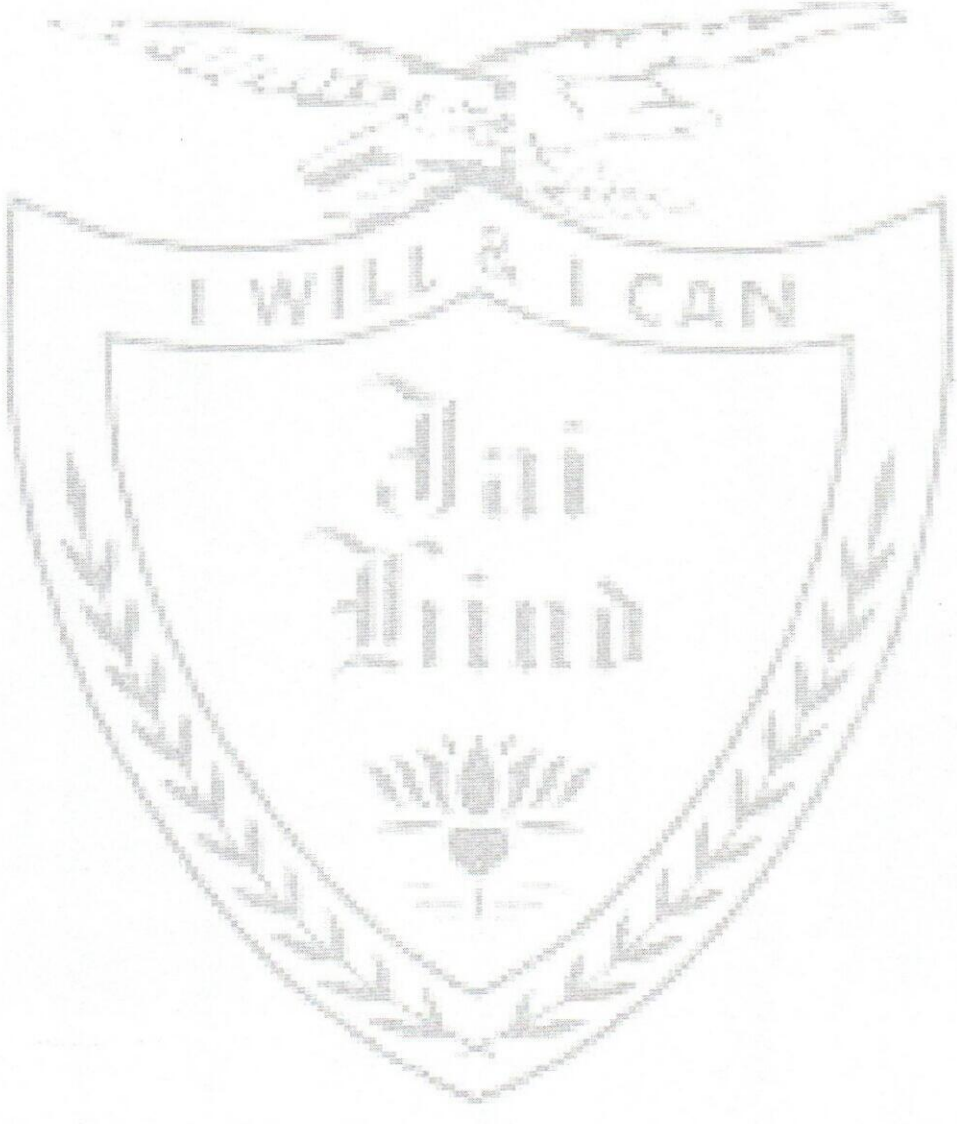
Credit Based Semester and Grading System (CBSGS) with effect from the academic year 2021-22

JAI HIND COLLEGE 'A' Road Churchgate Mumbai-20. AUTONOMOUS

PRINCIPAL
JAI HIND COLLEGE

M.Sc. Chemistry Syllabus

Semester I			
Course Code	Course Title	Credits	Lectures/Week
PSCHE104	Analytical Chemistry I	04	04



PRINCIPAL
JAI HIND COLLEGE

Semester I – Theory

Course Code: PSCHE104	Course Title: Analytical Chemistry I	Credits: 04 Lectures/Week: 04
	Course description: Language of Analytical Chemistry, Quality, Chemometrics, Optical Methods, XRF, XRD, Mass Spectrometry, Radio analytical methods	
	Objectives: **1. The students will learn advanced theoretical knowledge in Analytical Chemistry domain.** **2. Students will understand the working principle and instrumentation of various advanced analytical instruments.** **3. The students will acquire skill in performing analysis, record and analyse experimental data.** **Outcomes:** **1. Students will acquire thorough knowledge in theory, principle of instrumentation and various methodologies available for analysis of chemical samples.** **2. The students will be able to perform experimental chemistry with enough skill, prepare samples, understand methodologies and interpret experimental data.**	
Unit I	**Language of Analytical Chemistry [8L]** 1.1.1 Analytical perspective, Common analytical problems, terms involved in analytical chemistry (analysis, determination, measurement, techniques, methods, procedures and protocol) 1.1.2 An overview of analytical methods, types of instrumental methods, instruments for analysis, data domains, electrical and non-electrical domains, detectors, transducers and sensors, selection of an analytical method, accuracy, precision, selectivity, sensitivity, detection limit and dynamic range. 1.1.3 Quantitative methods of analysis: calibration curve, standard addition, and internal standard method. **Quality in Analytical Chemistry: [7L]** 1.2.1 **Quality Management System (QMS):** Evolution and significance of Quality Management, types of quality standards for laboratories, total quality management (TQM), philosophy implementation of TQM (reference of Kaizen, Six Sigma approach & 5S), quality audits and quality reviews, responsibility of laboratory staff for quality and problems. 1.2.2 **Safety in Laboratories:** Basic concepts of Safety in Laboratories, Personal Protection Equipment (PPE), OSHA, Toxic Hazard (TH) classifications, Hazardous Chemical Processes (including process calorimetry / thermal build up concepts).	**15L**

JAI HIND COLLEGE 'A' Road Churchgate Mumbai-20. AUTONOMOUS

PRINCIPAL
JAI HIND COLLEGE

	1.2.3 **Accreditations:** Accreditation of Laboratories, Introduction to ISO series, Indian Government Standards (ISI, Hallmark, Agmark) 1.2.4 **Good Laboratory Practices (GLP):**Principle, Objective, OECD guidelines, The US FDA 21CFR58, Klimisch score	
Unit II	**Calculations based on Chemical Principles [15L]** **The following topics are to be covered in the form of numerical problems only** a. Concentration of a solution based on volume and mass units. b. Calculations of ppm, ppb and dilution of the solutions, concept of mmol. c. Stoichiometry of chemical reactions, concept of kg mol, limiting reactant, theoretical and practical yield. d. Solubility and solubility equilibria, effect of presence of common ion. e. Calculations of pH of acids, bases, acidic and basic buffers. f. Concept of formation constants, stability and instability constants, stepwise formation constants. g. Oxidation number, rules for assigning oxidation number, redox reaction in term of oxidation number, oxidizing and reducing agents, equivalent weight of oxidizing and reducing agents, stoichiometry of redox titration (Normality of a solution of a oxidizing / reducing agent and its relationship with molarity).	**15L**
Unit III	**Optical Methods [15L]** 3.1 **Recapitulation and FT Technique [3L]** 3.1.1 Recapitulation of basic concepts, Electromagnetic spectrum, Sources, Detectors, sample containers 3.1.2 Laser as a source of radiation, Fibre optics 3.1.3 Introduction of Fourier Transform 3.2 **Molecular Ultraviolet and Visible Spectroscopy [6L]** (NUMERICALS ARE EXPECTED) 3.2.1 Derivation of Beer- Lambert's Law and its limitations, factors affecting molecular absorption, types of transitions [emphasis on charge transfer absorption], pH, temperature, solvent and effect of substituent. 3.2.2 Applications of Ultraviolet and Visible spectroscopy: Charge transfer absorption, simultaneous spectroscopy, derivative spectroscopy	**15L**

JAI HIND COLLEGE 'A' Road Churchgate Mumbai-20. AUTONOMOUS

PRINCIPAL
JAI HIND COLLEGE

	3.2.3 Dual spectrometry – Introduction, Principle, Instrumentation and Applications 3.3 **Infrared Absorption Spectroscopy [6L]** 3.3.1 Instrumentation: Sources, Sample handling, Transducers, Dispersive, non-dispersive instrument 3.3.2 FTIR and its advantages 3.3.3 Applications of IR [Mid IR, Near IR, Far IR]: Qualitative with emphasis on "Finger print" region, Quantitative analysis, Advantages and Limitations of IR 3.3.4 Introduction and basic principles of diffuse reflectance spectroscopy.	
Unit IV	**X-ray spectroscopy [7L]:** 4.1.1 **Fundamental principles:** a. Emission of X-rays b. Absorption spectra c. X-ray Fluorescence d. Diffraction of X rays 4.1.2 **Instrument components:** a. Sources of X-rays b. Filters c. X-ray monochromators d. X-ray Transducers & Signal Processors 4.1.3 **Principle, instrumentation & applications:** X-ray fluorescence & diffraction spectroscopy **Mass spectrometry [6L]:** 4.2.1 Introduction & Principles of mass spectrometry 4.2.2 Instrumentation: ion sources for molecular studies: electron impact, field ionization, field absorption, chemical ionization and fast atom bombardment sources; Introduction to mass analyzers. **Radioanalytical Methods [2L]:** 4.3.1 Recapitulation, isotope dilution method, introduction, principle, single dilution method and its applications.	**15L**

JAI HIND COLLEGE 'A' Road Churchgate Mumbai-20. AUTONOMOUS

PRINCIPAL
JAI HIND COLLEGE

Standard References:

Unit I

1. Fundamentals of Analytical Chemistry, By Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, 9th Edition, 2004, Ch: 5.
2. Undergraduate Instrumental Analysis, 6th Edition, J W Robinson, Marcel Dekker, Ch:1.
3. ISO 9000 Quality Systems Handbook, Fourth Edition, David Hoyle. (Chapter: 3 & 4) (Free download).
4. Quality in the Analytical Laboratory, Elizabeth Pichard, Wiley India, Ch: 5, Ch: 6 &Ch: 7.

Unit II

5. 3000 solved problems in chemistry, Schaums Solved problem series, David E. Goldbers, Mc Graw Hill international Editions, Chapter 11,15,16,21,22

Unit III

6. D. A. Skoog, F. J. Holler, T. A. Nieman, Principles of Instrumental Analysis, 5th Edition, Harcourt Asia Publisher. Chapter 6, 7.
7. H. H. Willard, L. L. Merritt, J. A. Dean, F. A. Settle, Instrumental Methods of Analysis,6 th Edition, CBS Publisher. Chapter 2.
8. R. D. Braun, Introduction to Instrumental Analysis, McGraw Hill Publisher. Chapter 8.

Unit IV

9. Principles of Instrumental Analysis - Skoog, Holler and Nieman, 5th Edition, Ch: 12
10. Principles of Instrumental Analysis - Skoog, Holler and Nieman, 5th Edition, Ch: 20
11. Essentials of Nuclear Chemistry, H J Arnikar, New Age Publishers (2005)
12. Fundamentals of Radiochemistry D. D. Sood , A. V. R. Reddy and N. Ramamoorthy

Additional References:

13. Quality Management, Donna C S Summers, Prentice-Hall of India, Ch:3.
14. Quality in Totality: A Manager's Guide To TQM and ISO 9000, ParagDiwan, Deep & Deep Publications, 1st Edition, 2000.
15. Quality Control and Total Quality Management - P.L. Jain-Tata McGraw-Hill (2006) Total Quality Management - Bester field - Pearson Education, Ch:5.
16. Industrial Hygiene and Chemical Safety, M H Fulekar, Ch:9, Ch:11 & Ch:15.
17. Safety and Hazards Management in Chemical Industries, M N Vyas, Atlantic Publisher, Ch:4, Ch:5 & Ch:19.
18. Staff, World Health Organization (2009) Handbook: Good Laboratory Practice (GLP)
19. OECD Principles of Good Laboratory Practice (as revised in 1997)". OECD Environmental Health and Safety Publications. OECD. **1**. 1998.
20. Klimisch, HJ; Andreae, M; Tillmann, U (1997). "A systematic approach for evaluating the quality of experimental toxicological and eco-toxicological data". doi:10.1006/rtph.1996.1076. PMID 9056496.
21. G. W. Ewing, Instrumental Methods of Chemical Analysis, 5 th Edition,

JAI HIND COLLEGE 'A' Road Churchgate Mumbai-20. AUTONOMOUS

PRINCIPAL
JAI HIND COLLEGE

McGraw Hill Publisher, Chapter 3.
22. M. Ito, The effect of temperature on ultraviolet absorption spectra and its relation to hydrogen bonding, J. Mol. Spectrosc. 4 (1960) 106-124.
23. A. J. Somnessa, The effect of temperature on the visible absorption band of iodine in several solvents, Spectrochim. Acta. Part A: Molecular Spectroscopy, 33 (1977) 525- 528.
24. Z. M. Khoshhesab (2012). Infrared Spectroscopy- Materials Science, Engineering and Technology. Prof. Theophanides Theophile (Ed.). ISBN: 978-953- 51-0537- 4, InTech,(open access)

Evaluation Scheme

- **Continuous Assessment (CA) – 40 Marks**
  - Knowledge and Application based: Objective test of 20 Marks
  - Skill based (20 marks): Learner will be assessed on relevant skills pertaining to the course content of a particular paper which could involve but not limited to
    Oral Presentations on relevant topics
    Review writing/Worksheets etc.
- **Semester End Examination (SEE)- 60 Marks**

JAI HIND COLLEGE 'A' Road Churchgate Mumbai-20. AUTONOMOUS

PRINCIPAL
JAI HIND COLLEGE

JAI HIND COLLEGE
BASANTSING INSTITUTE OF SCIENCE
&
J.T.LALVANI COLLEGE OF COMMERCE
(AUTONOMOUS)

"A" Road, Churchgate, Mumbai - 400 020, India.

Affiliated to
University of Mumbai

Affiliated to
University of Mumbai

Program: M.Sc. in Chemistry

Course: Analytical Chemistry Practical I

Semester I

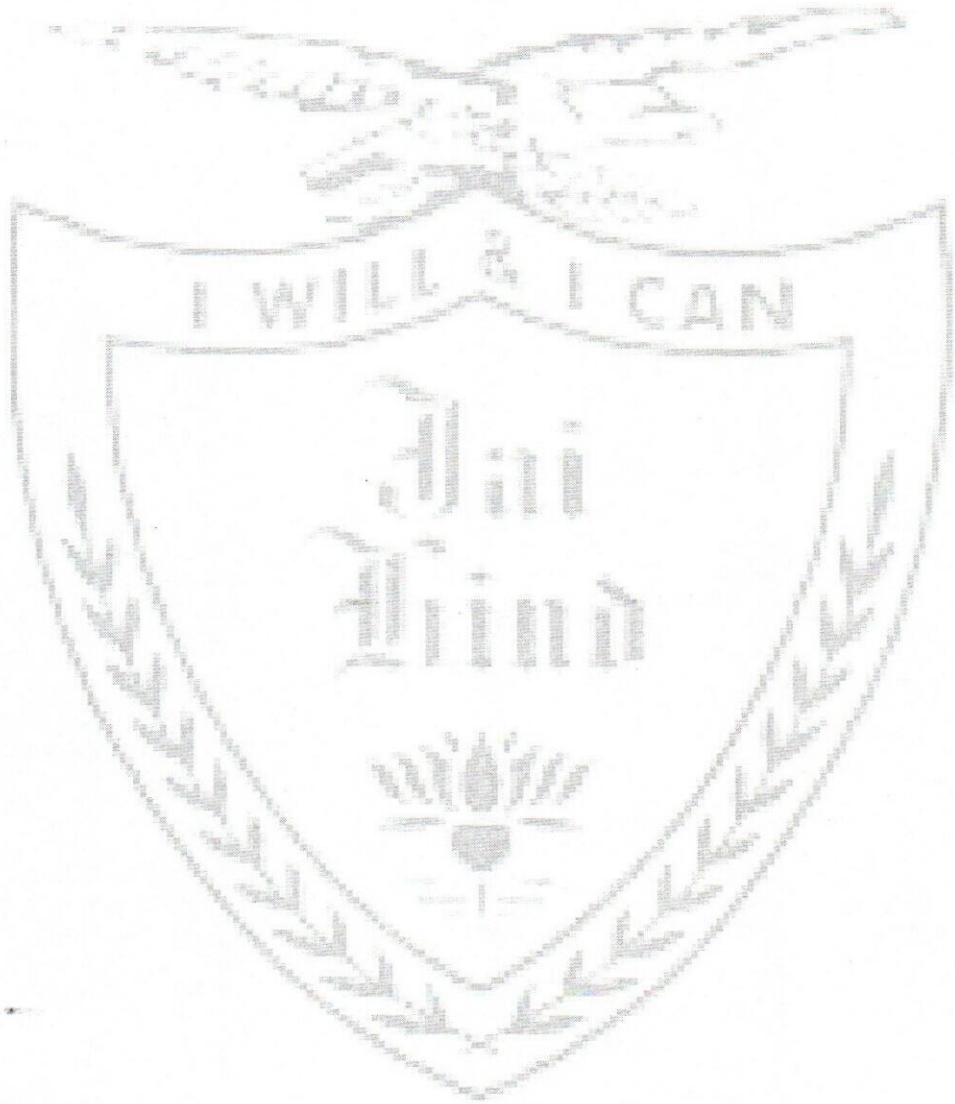
Credit Based Semester and Grading System (CBSGS) with effect from the academic year 2021-22

JAI HIND COLLEGE 'A' Road Churchgate Mumbai-20. AUTONOMOUS

PRINCIPAL
JAI HIND COLLEGE

M.Sc. Chemistry Practical Syllabus

Semester I			
Course Code	**Course Title**	**Credits**	**Practical/Week**
PSCHEPR104	**Analytical Chemistry Practical I**	**02**	**01**



PRINCIPAL
JAI HIND COLLEGE

Semester I – Practical

Course Code: PSCHEPR104	Course Title: Analytical Chemistry Practical I	Credits: 02 Practical /Week: 01

Objectives:

1. **To acquainted with procedures for assay of the sodium chloride injection by Volhard's method.**
2. **To develop the skill of determination of metals in alloys and mixtures.**
3. **To separate the components of a binary mixture by chemical/ Physical method.**

Outcomes:

1. **To understand different electrometric methods for the determination of the unknown component and their application to various samples.**
2. **To learn Learning of the ion-exchange methodology and application of it for separation and estimation of sample.**
3. **To understand spectrometry and practical training of determining the analyte from sample matrix.**

1. To carry out assay of the sodium chloride injection by Volhard's method. Statistical method.
2. To determine (a) the ion exchange capacity (b) exchange efficiency of the given cation exchange resin.
3. To determine amount of Cr(III) and Fe(II) individually in a mixture of the two by titration with EDTA.
4. To determine the breakthrough capacity of a cation exchange resin.
5. To determine the lead and tin content of a solder alloy by titration with EDTA.
6. To determine amount of Cu(II) present in the given solution containing a mixture of Cu(II) and Fe(II).
7. To determine number of nitro groups in the given compound using $TiCl_3$.

REFERENCES:

1. Quantitative Inorganic Analysis including Elementary Instrumental Analysis by A. I. Vogels, 3rd Ed. ELBS (1964)
2. Vogel's textbook of quantitative chemical analysis, Sixth Ed. Mendham, Denny, Barnes, Thomas, Pearson education
3. Standard methods of chemical analysis, F. J. Welcher
4. Standard Instrumental methods of Chemical Analysis, F. J. Welcher
5. W.W.Scott."Standard methods of Chemical Analysis",Vol.I, Van Nostrand Company,Inc.,1939.

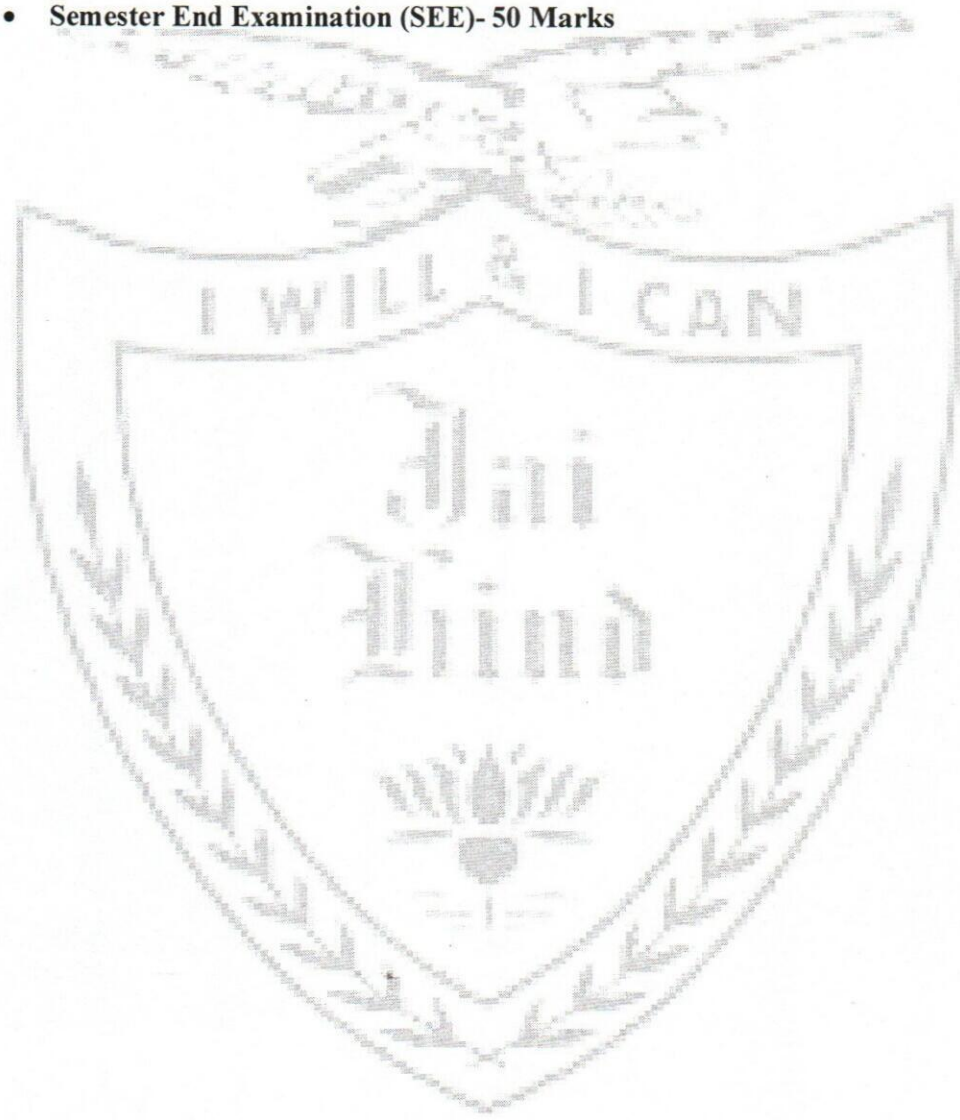
JAI HIND COLLEGE 'A' Road Churchgate Mumbai-20. AUTONOMOUS

PRINCIPAL
JAI HIND COLLEGE

	6. E.B.Sandell and H.Onishi,"Spectrophotometric Determination of Traces of Metals",Part- II,4th Ed.,A Wiley Interscience Publication,New York,1978.

Evaluation Scheme

- **Semester End Examination (SEE)- 50 Marks**



PRINCIPAL
JAI HIND COLLEGE