School of Chemistry
Faculty of Science
University of the Punjab, Lahore
Course Outline

BS Chemistry Semester-V					
Programme	**BS Chemistry**	**Course Code**	**Chem-301**	**Credit Hours**	**2**
Course Title	**Electrochemistry**		**Course Type**	**Major**	

Course Introduction

This course provides a comprehensive overview of electrochemistry, covering topics such as electrolyte conductance, the Debye-Huckle equation, ionic strength, activity coefficients, Concentration cells, and various types of fuel cells.
Here is a brief description of course outlines:
Basics of electrochemistry, Idea of conductance of electrolytes and its determination, Debye-Huckle equation for all types of solution and limiting law, ionic strength, weak electrolyte and Debye-Huckle theory, Activity and activity coefficients of electrolytic solution, determination of activities, concentration cells, Types of concentration cells, derivation of E.M.F of electrode and electrolyte concentration cells with and without transference, basics of Fuel cells, classification of fuel cells: Alkaline fuel cells, molten carbonate fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, Proton exchange membrane fuel cells and hydrocarbon fuel cells.

Learning Outcomes

By the end of this course, students will be able to

1. Understand and apply the principles of electrolyte conductance, the Debye-Hückel equation, and ionic strength
2. Determine activities and activity coefficients of electrolytic solutions
3. Analyze and derive the EMF of concentration cells
4. Classify and explain the functioning of various types of fuel cells.

	Course Content	Assignments/Readings
Week 1	Basic of Electrochemistry: Different tetralogy of electrochemistry	
	Molar conductance, Equivalent conductance, specific conductance their units and determination	
Week 2	Effect of various factors on conductance Cell constant and its determination	
	Continued	
Week 3	Continued	
	Activity and activity coefficient Determination of Activity for ideal and non ideal solutions Determination of activity coeffeicnet by solubility method	
Week 4	Determination of activity coefficient by E.M.F. method	
	Different theories of electrolyte	
Week 5	Continued	

	Debye-Huckle Law for strong electrolytes for very dilutes solutions	
Week 6	Quiz/assignments	
Week 7	Debye-Huckle Law for strong electrolytes for concentrated solutions	
	Debye-Huckle Law for weak electrolytes	
Week 8	Mid Term Examinations	
Week 9	Chemical cells and concentration cells	
	Types of concentration cells	
Week 10	derivation of E.M.F of electrode concentration cells without transference	
	Continued	
Week 11	Determination of E.M.F of electrolytes concentration cells without transference	
	Determination of E.M.F of electrolytes concentration cells with transference	
Week 12	Fuel cell, classification of fuel cells	
	Alkaline fuel cells,	
Week 13	molten carbonate fuel cells	
	phosphoric acid fuel cells	
Week 14	solid oxide fuel cells	
	Proton exchange membrane fuel cells	
Week 15	proton exchange membrane fuel cells and hydrocarbon fuel cells.	
Week 16	**Final Term Examinations**	

Textbooks and Reading Material

1. Bahl A. Bahl B.S. and Tuli G.D., Essentials of Physical Chemistry, S. Chand & Co., New Delhi, 2000.
2. Glasstone S., Physical Chemistry, Macmillan and Co. Ltd. St. marlins Street, London, 1995.
3. Bard, A. and Faulkner, L.R., Electrochemical Methods and applications, John Wiley, New York, 1980.
4. Sawyer, D. T., Sobcowiak, A., and Roberts, J. L., Electrochemistry for Chemists, John Wiley and Sons, New York, 1995.
5. Ullah, S., (2020) *"Ilmi Manual of Textbook of Physical Chemistry"*, Ilmi Kitab Khana, Lahore.
6. Ullah, S., (2020) *"A Textbook of Physical Chemistry"*, Ilmi Kitab Khana, Lahore.
7. Maron S.H. and Prutton C., Principles of Physical chemistry, the Macmillan Company, Collier Macmillan Ltd. London, 1965.

8. Barrow G.M., Physical Chemistry, McGraw Hill, Tokyo, 1973.
9. Moore W.J., Physical Chemistry, Rentice Hall, Englewood cliffs, Jersey, 1972.
10. Alberty, R.A. and Silbey, R.J., Physical Chemistry, McGraw Hill Book Company Ltd London, 1962.
11. Atkins P. & de Paula J., Physical chemistry, Oxford University Press, Walton Street, Oxford, 1989.

Teaching Learning Strategies

1. Lectures/Assessment
2. Group Discussion
3. Quiz/Short test
4. Seminar

Assignments: Types and Number with Calendar

1. Numerical problem sets relevant to topic will be given as assignments from week 1 to week 16.
2. Literature review based assignment relevant to the course will also be given during the course.

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester-V					
Programme	**BS Chemistry**	**Course Code**	**Chem-302**	**Credit Hours**	**1**
Course Title	**Physical Chemistry Lab**		**Course Type**	**Major Elective**	

Course Introduction

This course focuses on practical techniques in physical chemistry, including the preparation of buffer solutions, conductometric and potentiometric titrations, and the determination of Equivalence conductance to verify Ostwald's law. Here is a brief description of course outlines:

Preparation of buffer solution (CH_3COOH and CH_3COONa) of a certain pH.
Determination of the equivalence conductance of solution of weak electrolyte at various dilutions at room temperature to verify Oswald's law.
Determination of the strength of given solution of HCl by titrating it against standard solution of NaOH using conductomertic method.
Determination of concentration of acetic acid solution by titrating it against standard solution of NaOH using conductomertic method.
Determination of concentrations of HCl and CH_3COOH in the given mixture of both by titrating it against standard NaOH solution conductometrically.
Determination of the strength of given solution of HCl by titrating it against standard solution of NaOH using potentiometric/pH measurement method.

Learning Outcomes

On the completion of the course, the students will be able to:

1. prepare buffer solutions with specific pH values
2. determine the equivalence conductance of weak electrolytes to verify Ostwald's law
3. accurately measure the concentrations of various acids and acid mixtures using conductometric and potentiometric titration methods

	Course Content	Assignments/Readings
Week 1	Preparation of buffer solution (CH_3COOH and CH_3COONa) of a certain pH.	
	Continued	
Week 2	Continued	
	Continued	
Week 3	Continued	
	Determination of the equivalence conductance of solution of weak electrolyte at various dilutions at room temperature to verify Oswald's law.	
Week 4	Continued	
	Continued	
Week 5	Continued	
	Continued	
Week 6	Determination of the strength of given solution of HCl by titrating it against standard solution of NaOH using conductomertic method.	
	Continued	

Week 7	Continued	
	Continued	
Week 8	**Mid Term Examinations**	
Week 9	Determination of concentration of acetic acid solution by titrating it against standard solution of NaOH using conductomertic method.	
	Continued	
Week 10	Continued	
	Continued	
Week 11	Determination of concentrations of HCl and CH_3COOH in the given mixture of both by titrating it against standard NaOH solution conductometrically.	
	Continued	
Week 12	Continued	
	Continued	
Week 13	Determination of the strength of given solution of HCl by titrating it against standard solution of NaOH using potentiometric/pH measurement method.	
	Continued	
Week 14	Continued	
	Continued	
Week 15	Continued	
	Continued	
Week 16	**Final Term Examinations**	

Textbooks and Reading Material

1. Garland, C. W., Nibler, J. W., Shoemaker, D. P., Experiments in Physical Chemistry, 6th ed., WCB McGraw-Hill,1996.
2. Singh, A., Advanced Experimental Physical Chemistry, Campus Books International, 2007.
3. Daniels F., Experimental Physical Chemistry, 7th ed., McGraw-Hill College, 1970.
4. Matthews, G. P., Experimental Physical Chemistry, Oxford University Press, 1986.
5. Bhatti, H. N. & Farooqi, Z. H., Experimental Physical Chemistry for Graduate and Postgraduate Students, Revised ed., Caravan Book House, Lahore, 2014.

Teaching Learning Strategies

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

Assignments: Types and Number with Calendar
1. Lab activities and practical performance from week 1 to week 16. 2. Literature review based assignment relevant to the course will also be given during the course.

Assessment			
Sr. No.	**Elements**	**Weightage**	**Details**
4.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
5.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
6.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.