Lecture Plan

Name of the college: Government College of Arts, Science and Commerce, Sanquelim- Goa

Name of Faculty: Ankita M. Vernekar	**Subject:** Chemistry

Paper code: CHC-306 (Advanced Physical Chemistry-I)	**Program: T.Y.B.Sc.**	**Division:-**

Academic year: 2025 - 2026	**Semester:** VI	**Total Lectures:30**

Course Objectives: To develop conceptual clarity in electrochemical measurements, electrolyte theory, buffer action, modern energy devices, colloidal nanoscience.

Expected Course Outcome:

1. Explain the fundamental principles of electrochemical measurements, electrolyte behavior, buffer systems, energy devices, and colloidal nanomaterials.
2. Apply electrochemical and solution chemistry concepts to determine pH, solubility product, transport number, buffer capacity, and activity coefficients.
3. Analyze electrochemical phenomena and energy systems, including polarization, overvoltage, batteries, supercapacitors, solar cells, and fuel cells, using theoretical and graphical tools such as Tafel plots
4. Evaluate and relate the synthesis, performance, and applications of colloidal nanomaterials and energy devices for use in drug delivery, optoelectronics, imaging, and energy technologies.

Student Learning Outcome:

1. Explain the fundamental principles of electrochemical measurements, electrolyte behavior, buffer systems, energy devices, and colloidal nanomaterials.
2. Apply electrochemical and solution chemistry concepts to determine pH, solubility product, transport number, buffer capacity, and activity coefficients.
3. Analyse electrochemical phenomena and energy systems, including polarization, overvoltage, batteries, supercapacitors, solar cells, and fuel cells, using theoretical and graphical tools such as Tafel plots
4. Evaluate and relate the synthesis, performance, and applications of colloidal nanomaterials and energy devices for use in drug delivery, optoelectronics, imaging, and energy technologies.

Lecture From	Lecture To	No. of lectures allotted	Topic, Subtopic to be covered	Exercise/ Assignment	ICT Tools	Reference books
01/12/2025	06/12/2025	2	Applications of emf measurements-(i) determination of pH using hydrogen electrode, quinhydrone electrode, glass electrode,	Explain applications of EMF measurement	Power point presentation/ Smart board	N. B. Laxmeshwar, S. M. Malushte, A. S. Mulye and V. N. Kulkarni, Concepts of Physical Chemistry, Chetana Prakashan, Mumbai, 5th ed,1994. G. Raj, Advanced Physical Chemistry, Goel Publication, 36th edition, 2010, Meerut.
08/12/2025	13/12/2025	2	(ii) determination of solubility and solubility product of sparingly soluble salts, (iii) determination of ionic product of water	Explain applications of EMF measurement	Power point presentation/ Smart board	N. B. Laxmeshwar, S. M. Malushte, A. S. Mulye and V. N. Kulkarni, Concepts of Physical Chemistry, Chetana Prakashan, Mumbai, 5th ed,1994. G. Raj, Advanced Physical Chemistry, Goel Publication, 36th edition, 2010, Meerut.
15/12/2025	20/12/2025	1	determination of transport number. Polarisation; elimination of polarization;	Explain applications of EMF measurement	Power point presentation/ Smart board	N. B. Laxmeshwar, S. M. Malushte, A. S. Mulye and V. N. Kulkarni, Concepts of Physical Chemistry, Chetana Prakashan, Mumbai, 5th ed,1994. G. Raj, Advanced Physical Chemistry, Goel Publication, 36th edition, 2010, Meerut.
22/12/2025	23/12/2025	1	decomposition potential; measurement of decomposition potential; overvoltage and types of overvoltage;	Explain applications of EMF measurement	Power point presentation/ Smart board	N. B. Laxmeshwar, S. M. Malushte, A. S. Mulye and V. N. Kulkarni, Concepts of Physical Chemistry, Chetana Prakashan, Mumbai, 5th ed,1994. G. Raj, Advanced Physical Chemistry, Goel Publication, 36th edition, 2010, Meerut.
24/12/2025	01/01/2026		**CHRISTMAS BREAK**			
02/01/2026	10/01/2026	2	measurement of overvoltage; factors affecting overvoltage; Tafel plot. Buffer solution	Explain overvoltage	Power point presentation/ Smart board	N. B. Laxmeshwar, S. M. Malushte, A. S. Mulye and V. N. Kulkarni, Concepts of Physical Chemistry, Chetana Prakashan, Mumbai, 5th ed,1994. G. Raj, Advanced Physical Chemistry, Goel Publication, 36th edition, 2010, Meerut.
12/01/2026	17/01/2026	2	ISA 1, types, buffer action, buffer capacity, and mechanics of buffer action, .	Solve nummericals	Power point presentation/ Smart board	N. B. Laxmeshwar, S. M. Malushte, A. S. Mulye and V. N. Kulkarni, Concepts of Physical Chemistry, Chetana Prakashan, Mumbai, 5th ed,1994. G. Raj, Advanced Physical Chemistry, Goel Publication, 36th edition, 2010, Meerut.

19/01/2026	24/01/2026	2	Henderson equation for acidic and basic buffer. Debye Hückel theory of strong electrolytes Variation of activity coefficient with concentration, ionic strength, Debye Hückel limiting law.	State beer lamberts law	Power point presentation/ Smart board	N. B. Laxmeshwar, S. M. Malushte, A. S. Mulye and V. N. Kulkarni, Concepts of Physical Chemistry, Chetana Prakashan, Mumbai, 5th ed,1994. G. Raj, Advanced Physical Chemistry, Goel Publication, 36th edition, 2010, Meerut.
26/01/2026	31/01/2026	2	Energy sources: i) Batteries: Introduction to batteries, primary and secondary battery,	Difference between primary and secondary batteries	Power point presentation/ Smart board	N. B. Laxmeshwar, S. M. Malushte, A. S. Mulye and V. N. Kulkarni, Concepts of Physical Chemistry, Chetana Prakashan, Mumbai, 5th ed,1994. G. Raj, Advanced Physical Chemistry, Goel Publication, 36th edition, 2010, Meerut.
02/02/2026	07/02/2026	2	basic principles; rating and shelf life. Leclanché and Lead acid battery, Lithium ion batteries and rechargeability.	Explain lithium ion battery	Power point presentation/ Smart board	N. B. Laxmeshwar, S. M. Malushte, A. S. Mulye and V. N. Kulkarni, Concepts of Physical Chemistry, Chetana Prakashan, Mumbai, 5th ed,1994. G. Raj, Advanced Physical Chemistry, Goel Publication, 36th edition, 2010, Meerut.
09/02/2026	14/02/2026	2	Supercapacitors: Introduction to Supercapacitors, types of Supercapacitors,.	Explain supercapacitor	Power point presentation/ Smart board	N. B. Laxmeshwar, S. M. Malushte, A. S. Mulye and V. N. Kulkarni, Concepts of Physical Chemistry, Chetana Prakashan, Mumbai, 5th ed,1994. G. Raj, Advanced Physical Chemistry, Goel Publication, 36th edition, 2010, Meerut.
16/02/2026	21/02/2026	2	EDLC and Pseudocapacitors Advantages and limiations of supercapacitors.	Give advantages and applications	Power point presentation/ Smart board	N. B. Laxmeshwar, S. M. Malushte, A. S. Mulye and V. N. Kulkarni, Concepts of Physical Chemistry, Chetana Prakashan, Mumbai, 5th ed,1994. G. Raj, Advanced Physical Chemistry, Goel Publication, 36th edition, 2010, Meerut.
23/02/2026	28/02/2026	2	Photovoltaics: Solar cell, construction, working, advantages and disadvantages of silicon solar cell.	Explain solar cell	Power point presentation/ Smart board	N. B. Laxmeshwar, S. M. Malushte, A. S. Mulye and V. N. Kulkarni, Concepts of Physical Chemistry, Chetana Prakashan, Mumbai, 5th ed,1994. G. Raj, Advanced Physical Chemistry, Goel Publication, 36th edition, 2010, Meerut.
02/03/2026	07/03/2026	2	Fuel cells; H2-O2 fuel cell, molten carbonate fuel cell, proton exchange membrane fuel cell, solid-oxide fuel cell.	Explain different types of fuel cell	Power point presentation/ Smart board	N. B. Laxmeshwar, S. M. Malushte, A. S. Mulye and V. N. Kulkarni, Concepts of Physical Chemistry, Chetana Prakashan, Mumbai, 5th ed,1994. G. Raj, Advanced Physical Chemistry, Goel Publication, 36th edition, 2010, Meerut.

09/03/2026	14/03/2026	2	ISA 3, Preparation of colloids: hot injection method for synthesis of colloidal semiconductor nanocrystals/ quantum dots.	Give method of synthesis of colloids	Power point presentation/ Smart board	N. B. Laxmeshwar, S. M. Malushte, A. S. Mulye and V. N. Kulkarni, Concepts of Physical Chemistry, Chetana Prakashan, Mumbai, 5th ed,1994. G. Raj, Advanced Physical Chemistry, Goel Publication, 36th edition, 2010, Meerut.
16/03/2026	21/03/2026	2	Industrial methods of colloid synthesis. Applications of colloids:	Give applications of colloids	Power point presentation/ Smart board	N. B. Laxmeshwar, S. M. Malushte, A. S. Mulye and V. N. Kulkarni, Concepts of Physical Chemistry, Chetana Prakashan, Mumbai, 5th ed,1994. G. Raj, Advanced Physical Chemistry, Goel Publication, 36th edition, 2010, Meerut.
23/03/2026	28/03/2026	2	(i) Colloids as drug delivery agents in the form of liposomes, (ii) thin film processing of colloidal nanocrystal for their applications in LEDs, biological imaging.	Give applications of colloids	Power point presentation/ Smart board	N. B. Laxmeshwar, S. M. Malushte, A. S. Mulye and V. N. Kulkarni, Concepts of Physical Chemistry, Chetana Prakashan, Mumbai, 5th ed,1994. G. Raj, Advanced Physical Chemistry, Goel Publication, 36th edition, 2010, Meerut.
30/03/2026	31/03/2026	2	REVISION	-	Power point presentation/ Smart board	N. B. Laxmeshwar, S. M. Malushte, A. S. Mulye and V. N. Kulkarni, Concepts of Physical Chemistry, Chetana Prakashan, Mumbai, 5th ed,1994. G. Raj, Advanced Physical Chemistry, Goel Publication, 36th edition, 2010, Meerut.

Practical Plan

Name of the college: Government college of Arts Science and commerce Sanquelim Goa.		
Name of Faculty: Ms. Ankita M. Vernekar	**Subject:** Chemistry	
Paper code: CHC-306 (Advanced Physical Chemistry-I)	**Program: T.Y.B.Sc**	**Division: A**
Academic year: 2025- 2026	**Semester: VI**	**Total Practicals/Labs: 60 HOURS (16 PRACTICAL)**

Credits: 1

Course Objectives: - To develop students' ability to quantitatively analyze chemical systems using electrochemical, conductometric, potentiometric, adsorption, and colloidal techniques.

Expected Course Outcome:

1) **Perform conductometric and potentiometric experiments to determine electrolyte behavior, titration endpoints, and hydrolysis constants with accuracy.**
2) **Analyze acid–base systems by determining the strength and dissociation constants of weak acids and acid–salt mixtures using instrumental methods.**
3) **Estimate the percentage composition of halide mixtures and study adsorption phenomena, verifying adsorption isotherms experimentally.**
4) **Detect and quantify ultralow concentrations of metal ions using colloid-based analytical techniques and interpret the results scientifically.**

Student Learning Outcome:

1) **Perform conductometric and potentiometric experiments to determine electrolyte behavior, titration endpoints, and hydrolysis constants with accuracy.**
2) **Analyze acid–base systems by determining the strength and dissociation constants of weak acids and acid–salt mixtures using instrumental methods.**
3) **Estimate the percentage composition of halide mixtures and study adsorption phenomena, verifying adsorption isotherms experimentally.**
4) **Detect and quantify ultralow concentrations of metal ions using colloid-based analytical techniques and interpret the results scientifically.**

Month	Practicals/Labs Scheduled Date	No. of Practical's/Labs planned	List of Experiments	Reference books
December	01/12/2025-06/12/2025	2	Verification of Debye –Hückel Onsager equation using dilute solution of KCl by conductometric method.	1)Systematic experimental Physical Chemistry by W. Rajbhoj, T.K. Chondhekar, Anjali publication. 2)Senior Practical Physical chemistry by B.D. Khosla, V.C. Garg, Adarsh Gulati, published by R. Chand and Co
December	08/12/2025-13/12/2025	2	To determine the strength of mixture containing weak acid (CH3COOH) and salt of weak base (NH4Cl) by titrating against standard 0.1N NaOH solution conductometrically.	1)Systematic experimental Physical Chemistry by W. Rajbhoj, T.K. Chondhekar, Anjali publication. 2)Senior Practical Physical chemistry by B.D. Khosla, V.C. Garg, Adarsh Gulati, published by R. Chand and Co
December	15/12/2025-20/12/2025	2	To determine the strength of mixture containing weak acid (CH3COOH) and salt of weak base (NH4Cl) by titrating against standard 0.1N NaOH solution conductometrically.	1)Systematic experimental Physical Chemistry by W. Rajbhoj, T.K. Chondhekar, Anjali publication. 2)Senior Practical Physical chemistry by B.D. Khosla, V.C. Garg, Adarsh Gulati, published by R. Chand and Co

December	22/12/2025-23/12/2025	2	To determine hydrolysis and hydrolysis constant of Sodium Acetate /NH4Cl	1)Systematic experimental Physical Chemistry by W. Rajbhoj, T.K. Chondhekar, Anjali publication. 2)Senior Practical Physical chemistry by B.D. Khosla, V.C. Garg, Adarsh Gulati, published by R. Chand and Co
January	24/12/2025-01/01/2026		**CHRISTMAS BREAK**	
January	02/01/2026-10/01/2026	2	To determine hydrolysis and hydrolysis constant of Sodium Acetate /NH4Cl	1)Systematic experimental Physical Chemistry by W. Rajbhoj, T.K. Chondhekar, Anjali publication. 2)Senior Practical Physical chemistry by B.D. Khosla, V.C. Garg, Adarsh Gulati, published by R. Chand and Co
January	12/01/2026-17/01/2026	2	To determine potentiometrically the equivalence point of strong acid v/s strong base using quinhydrone and amount of acid present.	1)Systematic experimental Physical Chemistry by W. Rajbhoj, T.K. Chondhekar, Anjali publication.
January	19/01/2026-24/01/2026	2	To determine potentiometrically the equivalence point of strong acid v/s strong base using quinhydrone and amount of acid present.	1)Systematic experimental Physical Chemistry by W. Rajbhoj, T.K. Chondhekar, Anjali publication. 2)Senior Practical Physical chemistry by B.D. Khosla, V.C. Garg, Adarsh Gulati, published by R. Chand and Co
January	26/01/2026-31/01/2026	2	To determine the percentage composition and the amount of halides from a mixture (any two halides) using standard 0.1N AgNO3.	1)Systematic experimental Physical Chemistry by W. Rajbhoj, T.K. Chondhekar, Anjali publication. 2)Senior Practical Physical chemistry by B.D. Khosla, V.C. Garg, Adarsh Gulati, published by R. Chand and Co
February	02/02/2026-07/02/2026	2	To determine the percentage composition and the amount of halides from a mixture (any two halides) using standard 0.1N AgNO3.	1)Systematic experimental Physical Chemistry by W. Rajbhoj, T.K. Chondhekar, Anjali publication. 2)Senior Practical Physical chemistry by B.D. Khosla, V.C. Garg, Adarsh Gulati, published by R. Chand and Co
February	09/02/2026-14/02/2026	2	To determine dissociation constant of a weak monobasic acid (CH3COOH) by titrating against standard 0.1N NaOH using pH meter.	1)Systematic experimental Physical Chemistry by W. Rajbhoj, T.K. Chondhekar, Anjali publication. 2)Senior Practical Physical chemistry by B.D. Khosla, V.C. Garg, Adarsh Gulati, published by R. Chand and Co
February	16/02/2026-21/02/2026	2	To determine dissociation constant of a weak monobasic acid (CH3COOH) by titrating against standard 0.1N NaOH using pH meter.	1)Systematic experimental Physical Chemistry by W. Rajbhoj, T.K. Chondhekar, Anjali publication. 2)Senior Practical Physical chemistry by B.D. Khosla, V.C. Garg, Adarsh Gulati, published by R. Chand and Co
February	23/02/2026-28/02/2026	2	To study the adsorption of oxalic acid by charcoal and verifying Freundlich adsorption isotherm.	1)Systematic experimental Physical Chemistry by W. Rajbhoj, T.K. Chondhekar, Anjali publication. 2)Senior Practical Physical chemistry by B.D. Khosla, V.C. Garg, Adarsh Gulati, published by R. Chand and Co

March	02/03/2026-07/03/2026	2	To study the adsorption of oxalic acid by charcoal and verifying Freundlich adsorption isotherm.	1)Systematic experimental Physical Chemistry by W. Rajbhoj, T.K. Chondhekar, Anjali publication. 2)Senior Practical Physical chemistry by B.D. Khosla, V.C. Garg, Adarsh Gulati, published by R. Chand and Co
March	09/03/2026-14/03/2026	2	To detect the ultralow concentration of Cu2+ ions by silver colloids using colloid destabilization method.	1)Systematic experimental Physical Chemistry by W. Rajbhoj, T.K. Chondhekar, Anjali publication. 2)Senior Practical Physical chemistry by B.D. Khosla, V.C. Garg, Adarsh Gulati, published by R. Chand and Co
March	16/03/2026-21/03/2026	2	To detect the ultralow concentration of Cu2+ ions by silver colloids using colloid destabilization method.	1)Systematic experimental Physical Chemistry by W. Rajbhoj, T.K. Chondhekar, Anjali publication. 2)Senior Practical Physical chemistry by B.D. Khosla, V.C. Garg, Adarsh Gulati, published by R. Chand and Co
March	23/03/2026-28/03/2026	2	EXAM	

Assessment Rubrics

Component	Max Marks
ISA 1	7.5
ISA 2	7.5
Practical	25
Project	-
Semester End Exam	45