Name of Institute: Institute of Sciences, Humanities & Liberal Studies(ISHLS)
Name of Faculty: Dr. Paras Patel

Course code: MCH0322
Course name: Electroanalytical Techniques
Pre-requisites: B.Sc. (Chemistry)
Credit points:

L	T	P	C
4	0	0	4

Offered Semester: III

Course Coordinator (weeks XX - XX)
Full Name: Dr. Kuldeep Joshi
Department with siting location: Department of Chemistry
2nd Floor, Bhanwar Building
Telephone: EXT : 3213
Email: kuldeepjoshi.ishls@indusuni.ac.in
Consultation times: 4:15 pm to 5:00 pm (Monday to Friday)

Course Lecturer (weeks xx - XX)
Full name: Dr. Paras Patel
Department with siting location: Department of Chemistry
Room No. 425, 4th Floor, Bhanwar Building
Telephone: EXT : 3404
Email: paraspatel.gd@indusuni.ac.in
Consultation times: 02:30 pm to 5:00 pm (Friday)

Students will be contacted throughout the Session via Mail with important information relating to this Course.

Course Outcomes (CO)

By participating in and understanding all facets of this Course a student will:

1. Investigate interfacial studies for different electrochemical systems on the basis of electrocapillary phenomenon. [BT-5]
2. To explain the theory and principle of polarography and various factors involved in polarogram.[BT-2]
3. To illustrate the cyclic voltametry and its qualitative and quantative applications. [BT-4]
4. Discuss the cyclic voltammetry on the basis of shape of the peak in potential sweep curves, non- aqueous solution in cyclic voltammetry. [BT-2]
5. Comment on crieteria of reversibility and quasi reversible and irreversible processes. [BT-5]

6. Explain the principal of chemical sensing.[BT-2]

Course Outline
(Key in topics to be dealt)

- Electroanalytical Measurements.
- Electrodeposition, Coulometry, Amperometry.
- Voltammetry and Polarography
- Voltammetry and Chrono Techniques
- Electo-Chemical Sensors
- Physico-chemical Sensors and Transducers
- Biochemical Sensors

Method of delivery
(Face to face lectures, Active Learning Techniques)

Study time
(04 hours per week)

CO-PO Mapping (PO: Program Outcomes)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	-	1	-	-	-	-	-	-
CO2	3	1	3	2	1	2	-	-	-	-
CO3	3	3	3	3	-	3	2	-	-	-
CO4	2	2	2	1	-	-	-	-	-	-
CO5	1	1	-	-	1	-	-	-	-	-
CO6	2	-	1	-	-	2	-	-	-	-
MCH0322	**2.2**	**1.3**	**1.5**	**1.2**	**0.3**	**1.2**	**0.3**	**0.0**	**0.0**	**0.0**

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

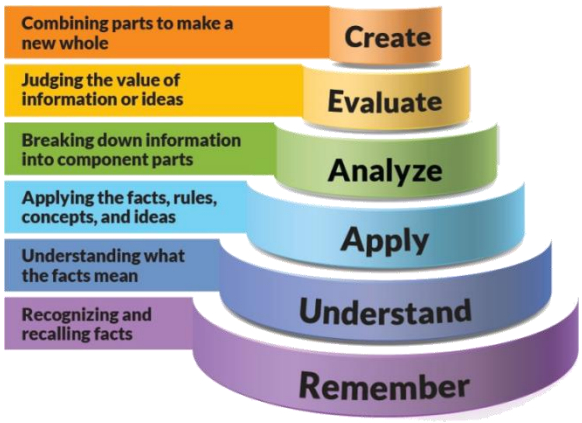

Figure 1: Blooms Taxonomy

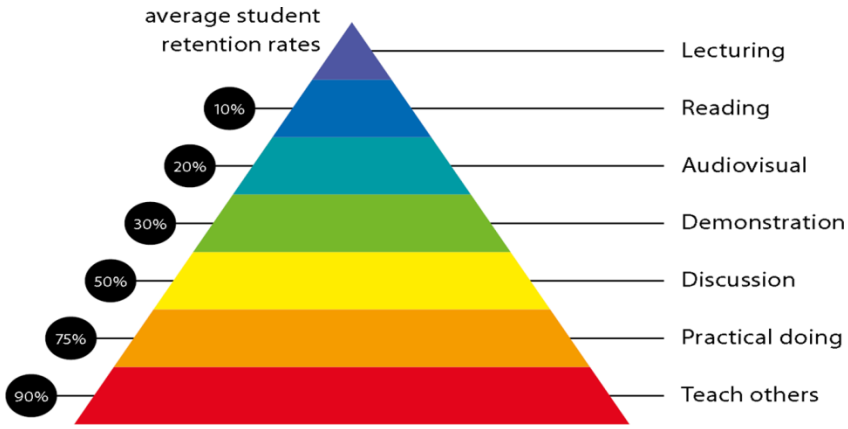

Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of Chemistry Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness:-** Student's will gain knowledge about chemistry subject in the both areas i.e. theory as well as practical's. Professionally students will know how chemistry is important in our daily life as well as to build up any industry. Students will be having knowledge/ awareness about chemicals' such as how to use them and how hazardous they are for the environment.

Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing:-** Student's will be able identify the problems happening in the society as well as in the industry such as Photochemistry, uses of Aromatic heterocyclic compounds and their reactions, Organic waste coming from the industries etc. with this basic information they will be having ability to gather the possible solutions.
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**3 Problem solving skills:** Organic Chemistry education provides students with the tools to solve many problems based on Chemistry. This means that students should be able to apply the scientific method: define a problem clearly, develop testable hypotheses, design and execute experiments, analyse data using appropriate statistical methods, and draw appropriate conclusions. Students should be able to integrate knowledge across chemical sub disciplines and apply this knowledge to solve problems. In the laboratory, in addition to the characteristics described above, students should understand the fundamental uncertainties in experimental measurements.
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**4 Written communication:-** Students should be able to retrieve specific information from the chemical literature, critically evaluate technical articles, and manage many types of chemical information. Students should able to develop proficiency with electronic searching of appropriate technical databases, including structure-based searching
	5 Oral communication:- Students should orally able to use communication technology such as computerized presentations as well as software for word processing, chemical-structure drawing, writing review article on any related topic, poster preparation and research paper presentation to any conferences.
	6 Teamwork:- Students should be able to Solve scientific problems often involves working in disciplinary and multidisciplinary

	teams. This is especially true in industry and increasingly in academic settings. Students should learn to work productively with a diverse group of peers in classroom and laboratory activities. Students should be able to lead portions of an activity or be effective followers, as dictated by the situation. Peer- and self-assessment is often an effective way to evaluate student contributions to group activities.
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**7 Sustainability, societal & environmental impact:** With this course students will know/ aware/ learn about the sustainable use of the organic reagents while performing the laboratory experiments. Students will be able to understand various photochemical reactions happening in the environment and their participation in global warming. So they will be having capabilities/ knowledge how to tackled/ deal with different types of organic pollutants coming from the organic laboratory and industry.

Lecture/tutorial times

(Give lecture times in the format below)_M.Sc. Chemistry _SEM-2

Example:

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.

Reference Books:

1. Modern Polarographic Methods in Analytical Chemistry, A. M. Bond, Marcel Dekker, New York (1980).
2. Electrochemical Methods, A. J. Bard and L. R. Faulkner, John Wiley, New York (1980).
3. Electrochemistry for Chemists, 2nd Ed., Donald T. Sawyer, A. Sobkowiak and J. L.
4. Roberts, Jr., John Wiley, New York (1994).
5. Cyclic Voltammetry and the frontiers of Electrochemistry, M. Noel and K. I. Vasu, IBH, New Delhi. (1990).
6. 5. Technique and Mechanism in Electrochemistry, P. A. Christensen and A. Hamnett, Blackie Academic and Professional (1994).
7. Electroanalytical Chemistry, Ed. A.J. Bard, Marcel Dekker, New York, A Series of volumes.
8. Electroanalytical Chemistry, J.J. Lingane, 2nd Ed., Interscience, New York (1958).
9. Principles of Instrumental Analysis, D.A. Skoog, F.J. Holler, and J.A. Nieman 5th Edition (1998).
7. Jiri Janata, Principles of Chemical Sensors, Plenum Press, 1990
8. Principles of Chemical and Biological Sensors, D. Diamond Editor, John Wiley& Sons, 2000.
9. Chemical Sensors and Biosensors, Brian Eggins, John Willey & Sons, 2002.
10. Sensors, Nanoscience, Biomedical Engineering, and Instruments. Richard Dorf Editor, CRC Taylor & Francis, 2006
11. 13. Optical Biosensors. Present & Future. Editors: F. Ligler, C. Rowe Taitt, Elsevier, 2002.
12. Introduction to Bioanalytical Sensors, Alice Cunningham, John Wiley& Sons, 1998.
13. Chemical Sensors and Biosensors for Medical and Biological Applications, Ursula Spichiger- Keller,Wiley-VCH, 1998.
14. Environmental Chemistry, A.K. De, 2nd Ed., Wiley, 1989.
15. Fundamentals of Environmental Chemistry. S.E. Manahan, 3rd Ed., CRC Press, 2009.
16. Solid and Hazardous Waste Management. S.C. Bhatia, Atlantic Publishers & Distributers(P) Ltd. New Delhi, 2007.
17. 19. Environmental pollution and Control. J. J. Peirce, R. F. Weiner and P. A. Vesilind, 4thEdn. Butterworth-Heinemann, USA, 1998.
18. E-waste: implications, regulations, and management in India and current global best practices. Rakesh Johri, TERI Press, New Delhi, 2009.

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

Example:

- **CIE (60 Marks)**

1. Mid Sem Exam = 40 Marks
2. Assignment = 10 Marks (2 assignment)
3.Presentation = 05 Marks
3. Attendance = 05 Marks (bonus for student having >80% attendance)

CIE Total = 60 Marks

- ESE (40 Marks)

1. ESE exam = 40 Marks

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

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Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Electroanalytical Measurements: Voltage, Impedance, The electric double layer, Electro capillarity, Current, Diffusion transport.	1&2	
	Weeks 2	Electrodeposition, Coulometry, Amperometry: Electrolysis, Current-Voltage relation.	1&2	
	Week 3	Electro gravimetric analysis at constant current, constant potential and at controlled potential, Coulometric analysis	1&2	
	Week 4	Voltammetry and Polarography: Necessity and development of new voltammetric techniques and their comparison with classical DC polarography.	2,3,&4	
	Week 5	Current sampled (TAST) polarography, Pulse (normal, differential and Differential double pulse)	2,3,&4	
	Week 6	Polarography, AC and square wave, linear sweep voltammetry and cyclic voltammetry, criteria of reversibility of electrochemical reactions, Quasi reversible and irreversible processes.	2,3,&4	
	Week 7	Voltammetry and Chrono Techniques: Stripping voltammetry, adsorptive stripping voltammetry.	2,3,4&5	
	Week 8	Voltammetry with ultra micro electrodes chemically modified electrodes, Amperometric titration, Applications of electrochemical methods in organic synthesis.	2,3,4&5	

	Week 9	Chrono techniques: Chronopotentiometry and Chronoamperometry, Chronocoulometry Quartz crystal microbalance:Principles, methodology and applications.	2,3,4&5	
	Week 10	Electo-Chemical Sensors: Introduction to principles of chemical sensing: Signal transduction, Physico-chemical and biological transducers, Sensor types and technologies. Screen-printed electrodes Physico-chemical Sensors and Transducers:	6	
	Week 11	Thermal sensors, Electrochemical sensors (amperometric, potentiometric, conductimetric), Semiconductor transducers (ISFET), Optical transducers Piezoelectric and (absorption, Acousticwave fluorescence, transducers, An bio/ chemiluminescence, Overview of Performance and Applications.	6	
	Week 12	Biochemical Sensors: Enzymes, Oligonucleotides and Nucleic Acids, Lipids (Langmuir-Blodgett bilayers, Phospholipids, Liposomes), Membrane receptors and transporters, Immun oreceptors.	6	
	Week 13	Applications: Environmental monitoring, Technological process control, Food quality control, Clinical chemistry, Test-strips for glucose monitoring, Screen printed electrodes, Implantable sensors for long-term monitoring, Forensic science.	6	
	Week 14	control, Clinical chemistry, Test-strips for glucose monitoring, Screen printed electrodes, Implantable sensors for long-term monitoring, Forensic science.	6	
	Week 15	Implantable sensors for long-term monitoring, Forensic science.	6	