Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Science College
Semester-4 (B.Sc)

**Subject:** Essentials of Physical Chemistry – BSCCM14313

**Type of course:** Minor

**Prerequisite:** Basic understanding of Physical chemistry is recommended.

**Rationale:** Study the basic knowledge of thermodynamics and their law with electro relation process in chemical industry. This course covers Thermodynamics zeroth , first, second and third law, Enthalpy and Heat capacity also electrochemistry which are related to thermo rule and in chemical kinetics factor affecting effect, zeroth, first and second order reaction and equilibrium .

## Teaching and Examination Scheme:

| Teaching Scheme | | | Credits | Examination Marks | | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | SEE | | CCE | | | |
| CI | T | P | C | Theory | Practical | MSE | LWA/V | ALA | |
| 3 | 0 | 2 | 4 | 75 | 25 | 30 | 20 | 50 | 200 |

*Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; SEE - Semester End Evaluation; MSE- Mid Semester Examination; LWA - Lab Work Assessment; V – Viva voce; CCE-Continuous and Comprehensive Evaluation; ALA- Active Learning Activities.*

## Course Content:

| Unit No | Course Content | Hrs | % Weightage |
|---|---|---|---|
| 1 | **Thermodynamics :** Introduction, Zeroth, first, second and third laws of thermodynamics, thermodynamic process , enthalpy, heat capacity, enthalpy of reactions, entropy, and Gibbs free energy, Helmholtz free energy. | 10 | 25% |
| 2 | **Electrochemistry** Definition and historical background, basic concepts, charge, current, voltage, conductors, types of electrochemical cell, galvanic and electrolytic cells, thermodynamics in | 15 | 25% |

| | | | |
|---|---|---|---|
| | electrochemistry, Gibbs free energy and cell potentials, half cell reactions, electrochemical series, Galvanic cells, construction, operation, calculating cell potentials, applications, electrolytic cell, principle, Faraday's laws of electrolysis, applications. Applications of electrochemistry like batteries, fuels cells, sensors and electrochemical devices. | | |
| 3 | **Chemical kinetics** Introduction to chemical kinetics, reaction rates, factor effecting on reaction rates, concentration, temperature pressure, catalyst, rate laws, determining rate laws from experimental data, reaction rate law for zero, first and second order reactions. | 10 | 25% |
| 4 | **Chemical Equilibrium** Introduction to chemical equilibrium, dynamic nature of equilibrium with example, the equilibrium constant(K), expression for equilibrium constant (Kc and Kp), calculating K from equilibrium concentrations, Le Chatelier's principle. | 10 | 25% |

**List of Practical :**

| Sr. No | Descriptions | Unit No | Hrs |
|---|---|---|---|
| 1 | Determination of cell constant and determination of normality of strong acid by conductometry titration (XNHCI → 0.5NaOH). | 1 | 3 |
| 2 | Determination of dissociation constant and normality of weak acid by pH-metry. (XN CH3COOH → 0.5N NaOH) | 1 | 3 |
| 3 | Determination of normality of strong acid by potentiometric titration. (XN HCI → 0.5N NaOH) | 1 | 3 |
| 4 | Determination of viscosity of given different percentage aqueous solutions of glycerin and determination of concentration of unknown solution, using viscometer. | 2 | 3 |
| 5 | Determination of specific rotation of given substance by preparing 10%, 5% and 2.5% solutions of cane sugar and determination of concentration of its unknown solution by polarimeter. | 2 | 3 |
| 6 | Determination of amount of ferric ion (Fe+3) in given solution by colorimeter. | 2 | 3 |

| | | | |
|---|---|---|---|
| 7 | Determination of dissociation constant and normality of weak acid by pH-metry. | 3 | 3 |
| 8 | To determine the temperature coefficient and energy of activation of hydrolysis of methyl acetate. | 3 | 3 |
| 9 | To investigate the reaction between potassium persulphate and potassium iodide. | 4 | 3 |
| 10 | Separation of amino acids by ascending paper chromatography. | 4 | 3 |
| | | Total | 30 |

**Continuous Assessment:**

| Sr. No | Active Learning Activities | Marks |
|---|---|---|
| 1 | **Thermodynamic Process Diagrams: P-V and T-S Diagrams** Faculty will give students a set of thermodynamic processes and ask them to sketch the corresponding Pressure-Volume (P-V) and Temperature-Entropy (T-S) diagrams and upload it on GMIU Web Portal. | 10 |
| 2 | **Electrochemical Series Exploration** Faculty will provide students with a list of half-reactions from the electrochemical series, and have them predict the outcome of various reactions and construct redox reaction equations and upload it to GMIU Web Portal. | 10 |
| 3 | **The Effect of Catalyst on Reaction Rate** Students will find different review papers and then review the rate of a reaction with and without a catalyst (e.g., using manganese dioxide as a catalyst for the decomposition of hydrogen peroxide) and they will upload their review on GMIU Web Portal and then with all the given reviews we will try to publish a another review paper. | 10 |
| 4 | **Equilibrium Constant for Gaseous Reactions – Kp and Kc** Faculty will provide students with equilibrium data for a gaseous reaction and have them calculate both $K_c$ (concentration-based) and $K_p$ (pressure-based). | 10 |
| 5 | **Attendance** | 10 |
| | **Total** | 50 |

## Suggested Specification table with Marks (Theory): 75

| Distribution of Theory Marks (Revised Bloom's Taxonomy) | | | | | | |
|---|---|---|---|---|---|---|
| Level | Remembrance (R) | Understanding (U) | Application (A) | Analyze (N) | Evaluate (E) | Create (C) |
| Weightage | 30% | 40% | 30% | 00 | 00 | 00 |

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

## Course Outcome:

| After learning the course the students should be able to: | |
|---|---|
| CO1 | Interpret and apply the Laws of Thermodynamics. |
| CO2 | Classify and differentiate between types of electrochemical cells. |
| CO3 | Analyze the impact of concentration, temperature, pressure, and catalysts on reaction rates. |
| CO4 | Calculate and interpret equilibrium constant. |

## Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
From the content 10% topics are suggested for flipped mode instruction.
Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory
The internal evaluation will be done on the basis of Active Learning Assignment
Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

## Reference Books:

[1] Introduction to Chemical Engineering Thermodynamics"; J. M. Smith, H. C.Van Ness, M. M. Abbott, The McGraw-Hill Companies, Inc.
[2] Chemical, Biochemical and Engineering Thermodynamics"; S.I. Sandler, Wiley India Edition.
[3] A text book of Chemical Engineering Thermodynamics"; K. V. Narayanan, Prentice-Hall of India Pvt. Ltd.
[4] Chemical and Process Thermodynamics"; B.G. Kyle, Prentice-Hall Inc.

[5] Introduction to Thermodynamics"; Y.V.C. Rao, 2nd Edition, Wiley Eastern Limited.