# Course Specification
## (Bachelor)

| | |
|---|---|
| Course Title: | **Chemistry of Colloids** |
| Course Code: | **CHM 1444** |
| Program: | **Bachelor of Science in Chemistry** |
| Department: | **Chemistry** |
| College: | **Science** |
| Institution: | **Imam Mohammad Ibn Saud Islamic University** |
| Version: | **2024 V1** |
| Last Revision Date: | 19 October 2024 |

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## A. General information about the course:

### 1. Course Identification

| | | | | | |
|---|---|---|---|---|---|
| **1. Credit hours: 2 (1 Lectures, 3 Lab, 0 Tutorials)** | | | | | |
| **2 (1 Lectures, 3 Lab, 0 Tutorials)** | | | | | |
| **2. Course type** | | | | | |
| **A.** | ☐University | ☐College | ☒ Department | ☐Track | ☐Others |
| **B.** | ☐ Required | | ☒ Elective | | |
| **3. Level/year at which this course is offered: Level 7 / Year 4** | | | | | |
| **4. Course general Description:** | | | | | |
| **The course will give knowledge about the Colloidal State of matter: Classification, preparation and physical properties, Electro kinetic phenomena, Colloidal electrolytes and their uses, Emulsion, preparation, properties, stability, and use. Surface Chemistry: Solid surfaces and their characterization; Adsorption on solid surfaces: technique for measurement of adsorption from gas phase and solution; Langmuir, Freundlich and BET adsorption isotherm: Enthalpy of adsorption; Adsorption on liquid surface. Gibb's adsorption equation; Surface film; Electro-capillary phenomena.** | | | | | |
| **5. Pre-requirements for this course** (if any)**:** | | | | | |
| **Physical Chemistry (2) –CHM 242** | | | | | |
| **6. Co-requisites for this course** (if any)**:** | | | | | |
| **None** | | | | | |
| **7. Course Main Objective(s):** | | | | | |
| ***At the end of the course, Students should be able:*** <br>• **Describe the basic principles of colloid preparation, purification, stability theory, instability, and main types of stabilization.** <br>• **Outline the electro-kinetic and optical properties of colloids.** <br>• **Define surface chemistry and adsorption-desorption process.** <br>• **List techniques for measurement of adsorption from gas phase and solution.** <br>• **Analyze data and results through analytical thinking, evaluating the gained information.** <br>• **Operate laboratory instruments and diagram and illustrate experimentally obtained data.** | | | | | |

### 2. Teaching mode (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | **60** | **100%** |
| 2 | E-learning | **0** | **0** |
| 3 | Hybrid <br>• Traditional classroom | **0** | **0** |

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| | • E-learning | | |
| 4 | Distance learning | 0 | 0 |

### 3. Contact Hours (based on the academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1. | **Lectures** | **15** |
| 2. | **Laboratory/Studio** | **45** |
| 3. | **Field** | **0** |
| 4. | **Tutorial** | **0** |
| 5. | **Others (specify)** | **0** |
| **Total** | | **60** |

## B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| **1.0** | **Knowledge and understanding** | | | |
| **1.1** | **To memorize the state, classification, and physical properties of colloids.** | **K1; K2; K3;** | • Four hours are weekly, containing lectures and laboratory activities.<br>• A Private study including a home exam. | • Quizzes<br>• Assignments<br>• Discussions.<br>• Participation |
| **1.2** | **To describe the basic principles of colloid preparation, purification, stability theory, instability, and main types of stabilization.** | **K1; K2; K3** | • Four hours weekly containing lectures and Laboratory activities<br>• Group discussion | • Quizzes<br>• Assignments.<br>• Oral Discussion<br>• Laboratory Reports |
| **1.3** | **To outline the electro-kinetic and optical properties of colloids.** | **K1** | • lectures and Laboratory activities<br>• Group discussion | ▪ Quizzes<br>▪ Home exam<br>▪ Oral Discussions.<br>▪ laboratory reports |

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| 1.4 | **To define surface chemistry and the adsorption-desorption process, and list techniques for measuring adsorption.** | **K1; K3** | • Laboratory activities<br>• Group discussion<br>. | ▪ Participation,<br>▪ Quizzes and<br>▪ MCQs,<br>▪ laboratory performance |
| **2.0** | **Skills** | | | |
| **2.1** | **To calculate Adsorption parameters using problems and their solutions and estimate kinetic, physical, and optical parameters of colloidal systems.** | **S1; S2; S3** | Introduce some examples of Adsorption parameters using problems | • Questions in Lectures.<br>• Short Quizzes and Exams.<br>• Participation<br>• Oral Discussion,<br>• Laboratory Reports<br>• Home Exam. |
| **2.2** | **To analyze data and results through analytical thinking, with evaluation of the gained information.** | **S1; S2; S3** | • Group Discussions<br>• Laboratory Experiments | • Questions in Lectures.<br>• Laboratory Reports<br>• Short Quizzes and Exams.<br>Oral Discussion |
| **2.3** | **To demonstrate skills to participate in class by asking questions and giving answers.** | **S3** | • Lectures<br>• Oral Discussions.<br>• Brainstorming Exercises | • Questions in Lectures.<br>• Short Quizzes<br>• Exams. |
| **2.4** | **To diagram and explain experimentally obtained data during laboratory classes and field tasks, and to demonstrate oral and network communication and technical writing skills.** | **S2; S4** | • Encourage the students to use the Chemicals, Glassware, and Instruments with caring and safety<br>• Laboratory activities. | • Assignments<br>• Laboratory Report. |
| 3.0 | Values, autonomy, and responsibility | | | |
| **3.1** | **To appraise coordination and raise knowledge during various evaluations,** | **V1; V2** | • Brain Storms Exercises<br>• Group Discussion | • Oral Discussion.<br>• Group Discussion<br>• Assignments |

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| | **initiatives, and mini reports to uphold scientific integrity.** | | | • Group work sheets |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **History,** component, dispersed phase, dispersion medium, micelles, aggregation, classification, Lyophilic , Lyophobic properties, Tyndall effect, Brownian movement, Adsorption, Electrical charge, Zeta potential, electrophoresis.Preparation, dispersion method, Bredig's Electric Arc, mechanical dispersion, Ultrasonic Dispersion, peptization dispersion, Condensation or Aggregation Methods, Lowering of solubility by exchange of solvent, Passing vapours of an element into a liquid, Excessive cooling, Preparation of colloidal sol by chemical methods.<br>**Purification**, Dialysis, Electrodialysis, Ultra-filtration, Ultra-centrifugation; Application and chemical impact, Removal of dirt from sewage, Leather tanning, Laundry, medicine, Colloid Chemistry | 3 |
| 2 | Sedimentation: driving force, liquid resistance, frictional coefficient, Stoke's law, sedimentation rate. Brownian motion, Diffusion, rate of diffusion, Fick's first law, diffusion coefficient, average translational kinetic energy, Einstein's equation.Ultracentrifuge, centrifugal force, sedimentation velocity, sedimentation coefficient. | 3 |
| 3 | **Light scattering**: Tyndall effect, turbidity, size and shape, Debye scattering, Rayleigh Scattering, Molar Masses, Doppler Broadening; Ultramicroscope. micro electrophoresis, particle charge, resolution | 2 |
| 4 | **Theory of stability**, instability, main types of stabilization, Van der Waals attractive interactions, Hamaker constants; DLVO Theory, Electrostatic stability, Electric double layer, resultant (total) potential, conditions for colloid stability, thermodynamic and kinetic aspects | 2 |
| 5 | **Introduction, Bulk, surface**, Adsorption, adsorbate, adsorbent, Desorption, Occlusion, absorption, Physisorption, Chemisorption, surface area, Temperature, pressure, Applications. Adsorption at Solid Liquid interface. Adsorption at Solid Gas interface, specific surface area. Adsorption isotherm, thermodynamic consideration, equilibrium, Henry's equation, Freundlich isotherm, Langmuir isotherm, Potential theory of adsorption, Dubinin-Radushkevich, The BET theory, Capillary condensation, Pores classification, surface tension | 5 |
| | Total | 15 |

*Topics to be covered (Laboratories)*

| | | |
|---|---|---|
| **Lab 01** | Safety and Laboratory equipment and measurements and How to make a report | **1** |
| **Lab 02** | Preparation of colloid solutions and measuring their optical properties | 5 |
| **Lab 03** | Determination of the flocculation value of $Fe(OH)_3$ sol | 3 |
| **Lab 04** | Emulsion and emulsifying agent and determination of stability | 3 |
| **Lab 05** | Determination of the type of emulsion | 3 |
| **Lab 06** | Determination of critical micelle concentration of sodium dodecyl sulphate (SDS) from the measurement of conductivities | 3 |
| **Lab 07** | Viscosity: Part 1: Determination of the time of flow for a given pure solvent.<br>Part 2: Determination of the radius of a molecule (glycerol). | 6 |
| **Lab 08** | Determination of the molecular mass of polyvinyl chloride from viscosity | 3 |
| **Lab 09** | Surface Tension of Liquids | 3 |
| **Lab 10** | Determination the surface adsorption of amyl alcohol (or tween 80) from aqueous solutions using capillary rise method. | 3 |
| **Lab 11** | Determination of the adsorption isotherm of oxalic acid on bone charcoal. | 3 |
| **Lab 12** | Determination of Heat of Adsorption of Acetic Acid on Charcoal | 3 |
| **Lab 13** | Analysis of the experimental data obtained in Lab 11 and Lab 12 | 3 |
| **Lab 14** | Review | 3 |
| **Total** | | **45** |

## D. Students Assessment Activities

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | **Midterm 1** | **6th/ 7th week** | **10 %** |
| 2 | **Midterm 2** | **11th/ 12th week** | **10 %** |
| 3 | **Quizzes, Home Works, class participation, and mini-projects** | **During the semester** | **10 %** |
| 4 | **Laboratory** | **15th week** | **30 %** |
| 5 | **Final Exam** | **All the semester** | **40 %** |
| 6 | **Total** | **16- 17th week** | **100 %** |

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

## E. Learning Resources and Facilities

### 1. References and Learning Resources

| | |
|---|---|
| Essential References | ***Principle of Colloids and Surface Chemistry.*** Duncan J. Shaw, 4th Edition esc, PhD, FRS, Liverpool Polytechnic, (ISBN 07506 11820). |
| Supportive References | ***Colloid Science: Principles, Methods and Applications,*** Terence Cosgrove , Blackwell (2005).<br>***Principle of Colloids and Surface Chemistry,*** Hiemenz and Raj Rajagopala 3rd Edition, CRC (1997). |
| Electronic Materials | **Blackboard**<br>**http://www.funsci.com/fun3_en/exper2/exper2.htm**<br>**http://www.kt.dtu.dk/english/Education/Continuing_education/Business/Colloid_and_surface_chemistry.** |
| Other Learning Materials | **None** |

## 2. Required Facilities and equipment

| Items | Resources |
|---|---|
| **facilities**<br>(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | • Each of the class room should be equipped with a whiteboard and a projector, with a maximum of 20 students.<br>• In each laboratory, a list of safety and precautions are provided.<br>• In each lab has proper ventilation and is well equipped with instruments.<br>• In each lab, there are containers for solid waste, liquid waste, and crushed glasses.<br>• Each lab has a small pharmacy for first aid in case of an accident<br>• In each lab, the rules, conditions, and safety mechanism as well list of Risks, Safety precautions according to Merck Catalogue, are hanging in the lab<br>• Appropriate Glasswares for carrying the requested experiments (conical flasks, beakers, measuring cylinders)<br>• Appropriate fine chemicals and solvents (distilled Water ammonium nitrate)<br>• Analytical balance (3 digits), Set gas laws with the glass jacket Data acquisition set for gas laws with glass jacket, PC, Windows® 95 or higher, calorimeter, thermometer, Filter papers , clamps, stands |
| **Technology equipment**<br>(projector, smart board, software) | |

| Items | Resources |
|---|---|
| | The rooms are equipped with a data show, Smart Board, and WI-FI access. |
| **Other equipment**<br>(depending on the nature of the specialty) | |

## F. Assessment of Course Quality

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Effectiveness of teaching | **Students** | **Direct:** Questionnaire. |
| | **Course Responsible** | **Direct:** Course e-Portfolio.<br>**Indirect:** Second examiner checklist- Course report. |
| | **Peer Reviewer** | **Direct:** Questionnaire.<br>**Indirect:** External assessor report. |
| Effectiveness of students assessment | **Program Leaders** | **Direct:** Course e-Portfolio.<br>**Indirect:** Course report. |
| Quality of learning resources | **Students** | **Indirect:** Second examiner checklist- Course report. |
| | **Faculty (Academic Advisory)** | **Direct:** course Entrance/Exit.<br>**Indirect:** Observations - Accreditation review. |
| | **Program Leaders** | **Direct:** Course e-Portfolio.<br>**Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review. |
| The extent to which CLOs have been achieved | **Course Responsible** | **Direct:** Exams - Course e-Portfolio.<br>**Indirect:** Second examiner checklist- Course report. |
| | **Program Leaders** | **Indirect:** Exams. |

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Other | | |

**Assessors** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

**Assessment Methods** (Direct, Indirect)

## G. Specification Approval

| | |
|---|---|
| **COUNCIL /COMMITTEE** | **COUNCIL OF DEPARTMENT OF CHEMISTRY** |
| **REFERENCE NO.** | **7 (NO. 2/3)** |
| **DATE** | **29/3/1446 - 2/10/2024** |