Module Descriptions

Module designation	AI in Chemistry Learning
Semester(s) in which the module is taught	7th/Fourth Year
Person responsible for the module	Dr. Kusumawati Dwiningsih, S.Pd., M.Pd.
Language	Bahasa Indonesia (Regular Class) English (Internasional Class)
Relation to curriculum	Undergraduate course in the S1 Chemistry Education Study Program, Universitas Negeri Surabaya.
Teaching methods	Project-Based Learning (PjBL), guided exploration, demonstrations, inquiry learning, group discussion, workshops, collaborative learning, peer review, project consultation, and microteaching/simulation. 2 workhours per week (2 x 170 minutes per week)
Workload (incl. contact hours, self-study hours)	2 Credit Units (CU). Based on the workload convention in the supplied Module Descriptions template (1 CU = 170 minutes per week over 14 weeks, excluding midterm and final examinations), the estimated workload is 79.33 hours per semester, equivalent to approximately 3.18 ECTS.
Credit points	2 Credit Units (CU) = 3.18 ECTS
Required and recommended prerequisites for joining the module	No prerequisite is explicitly stated in the attached RPS.
Module objectives/intended learning outcomes	Upon successful completion of this course, students are expected to: 1. Critically and systematically analyze the concepts, potential, limitations, and outputs of AI technologies in chemistry learning based on scientific and pedagogical principles. 2. Design AI-assisted chemistry learning that aligns with learning objectives, the characteristics of chemistry content, learner needs, and pedagogical principles. 3. Develop and implement AI-based chemistry learning media or solutions creatively, interactively, and with a learner-centered orientation. 4. Evaluate and improve AI-based chemistry learning solutions using implementation evidence while

	considering ethics, humanistic values, academic integrity, and responsible AI use.
Content	This course equips prospective chemistry teachers with critical, pedagogical, and responsible AI literacy. Students explore foundational concepts of artificial intelligence, machine learning, generative AI, and large language models, and critically examine their opportunities and limitations in education. Through Project-Based Learning, students use AI to design, develop, test, evaluate, and refine chemistry learning experiences and products. Particular emphasis is placed on verifying AI-generated content, including chemistry concepts, calculations, chemical equations, nomenclature, visualizations, and the connections among macroscopic, submicroscopic, and symbolic representations. Students also consider assessment design that promotes reasoning, data privacy, bias, academic integrity, transparency in AI use, ethics, and humanistic values. The project culminates in an AI-assisted chemistry learning product that is tested through a limited trial, simulation, or microteaching and improved based on evidence and feedback.
Examination forms	Project/product assessment, portfolio assessment, presentations, reports, reflective writing, demonstrations, peer assessment, and analysis of implementation data. The midterm assessment is a project presentation of an AI-assisted learning design portfolio and initial prototype. The final course work includes evaluation and revision of the AI-assisted chemistry learning product and reflection on ethical and responsible AI use.
Study and examination requirements	Students are expected to complete individual and group assignments, maintain documentation of prompts and AI outputs, verify generated information against credible sources, participate in discussions and peer review, develop a product blueprint and prototype, conduct a limited trial or microteaching, prepare evaluation instruments, analyze feedback and implementation evidence, revise the product, and submit a final product with supporting documentation. Assessment evidence includes portfolios, product quality, presentations, reports, implementation records, analysis, and reflection. The attached RPS does not specify an overall percentage breakdown for assessment components.
Reading list	1. Li, Y., Tolosa, L., Rivas Echeverria, F., & Marquez, R. (2026). Translating UNESCO artificial intelligence guidelines to chemical education and its implications for sustainable development goals. Journal of Chemical Education, 103, 1135–1144. https://doi.org/10.1021/acs.jchemed.5c00819

	2. Berber, S., Brückner, M., Maurer, N., & Huwer, J. (2025). Artificial intelligence in chemistry research—Implications for teaching and learning. Journal of Chemical Education, 102, 1445–1456. https://doi.org/10.1021/acs.jchemed.4c01033 3. Tassoti, S. (2024). Assessment of students' use of generative artificial intelligence: Prompting strategies and prompt engineering in chemistry education. Journal of Chemical Education, 101, 2475–2482. https://doi.org/10.1021/acs.jchemed.4c00212 4. Iyamuremye, A., et al. (2024). Utilization of artificial intelligence and machine learning in chemistry education: A critical review. Discover Education. https://doi.org/10.1007/s44217-024-00197-5 5. Erümit, A. K., & Sarıalioğlu, R. Ö. (2025). Artificial intelligence in science and chemistry education: A systematic review. Discover Education, 4, 17. https://doi.org/10.1007/s44217-025-00622-3 6. Reyes, R. L., & Regala, J. D. (2026). Reimagining the philosophy of experimentation in chemistry education: Embracing AI as a tool for scientific inquiry. Science & Education, 35, 709–754. https://doi.org/10.1007/s11191-025-00667-8