

## Subject Description Form

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| <b>Subject Code</b>                                   | CSE29371                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Subject Title</b>                                  | Environmental Chemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Credit Value</b>                                   | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Level</b>                                          | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Pre-requisite/<br/>Co-requisite/<br/>Exclusion</b> | Pre-requisites:<br>ABCT1700 Introduction to Chemistry (exemption: achieve required grades in chemistry in HKDSE and/or JEE)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Objectives</b>                                     | The subject aims to provide the student with an understanding of chemical reactions and chemical processes in water and air, in both natural and human perturbed environments. The subject will include lectures, tutorials, laboratories, and seminars for linking chemistry principles to current environmental pollution issues and solutions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Intended Learning Outcomes</b>                     | Upon completion of the subject, students will be able to: <ul style="list-style-type: none"> <li>a. understand the basic concepts of environmental chemistry in water, soil, and air;</li> <li>b. understand the chemistry behind environmental issues, in both the natural or engineered systems;</li> <li>c. integrate the chemical principles into environmental practices;</li> <li>d. exercise the experimental works in the laboratory and incorporate the results into technical reports to describe the observed phenomenon and scientific findings;</li> <li>e. recognize the need for, and to engage in life-long learning;</li> </ul>                                                                                                                                                                                                                                                                             |
| <b>Subject Synopsis/<br/>Indicative Syllabus</b>      | <p><b><u>Keyword syllabus:</u></b></p> <ol style="list-style-type: none"> <li>1. <u>Water Quality Indexes</u><br/>Introduction to the basic water quality indexes and the chemistry concepts, including biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), total dissolved solids (TDS), color, alkalinity, and hardness;</li> <li>2. <u>Water Chemistry</u><br/>Introduction to the principles and applications of carbon/nitrogen cycles, equilibrium equations, reduction and oxidation reactions, reaction orders in environmental studies; introduction to pH, acid-base equilibrium and alkalinity in aquatic system;</li> <li>3. <u>Atmospheric Chemistry</u><br/>Structure of the atmosphere, solar radiation, oxidative capacity, free radicals, oxidation of nitrogen oxides, sulphur compounds, volatile organic compounds, acid-base reactions, composition</li> </ol> |

|                                                                        | <p>and reactions of aerosol, basics of chemical kinetics; photochemical smog, acid rain, haze, and stratospheric ozone depletion.</p> <p>4. <u>Laboratory Works</u><br/>Perform basic water quality experiments such as BOD, COD, TSS, TDS, total nitrogen, alkalinity and hardness tests; numerical simulations of photochemical mechanisms.</p> <p>5. <u>Seminar</u><br/>Introduction to environmental issues and the state-of-the-art technologies to resolve the problems in air, water, and wastes.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                   |   |                        |   |   |                                   |             |                                                   |  |  |  |  |   |   |   |   |   |                |     |   |   |   |  |  |                       |     |   |   |  |   |  |                   |    |   |  |   |  |   |          |     |   |   |   |  |  |                      |     |   |   |   |  |  |       |      |  |  |  |  |  |
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| <b>Teaching/Learning Methodology</b>                                   | Fundamental knowledge will be covered in the lectures. Tutorials will provide opportunities for discussion of lecture materials and will also be conducted with problem-solving sessions to supplement understanding from lectures. Laboratory works will help students to appreciate the basic principles and familiarize themselves with basic water, soil, and air chemistry.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                   |   |                        |   |   |                                   |             |                                                   |  |  |  |  |   |   |   |   |   |                |     |   |   |   |  |  |                       |     |   |   |  |   |  |                   |    |   |  |   |  |   |          |     |   |   |   |  |  |                      |     |   |   |   |  |  |       |      |  |  |  |  |  |
| <b>Assessment Methods in Alignment with Intended Learning Outcomes</b> | <table border="1"> <thead> <tr> <th rowspan="2">Specific assessment methods/tasks</th><th rowspan="2">% weighting</th><th colspan="5">Intended subject learning outcomes to be assessed</th></tr> <tr> <th>a</th><th>b</th><th>c</th><th>d</th><th>e</th></tr> </thead> <tbody> <tr> <td>1. Assignments</td><td>15%</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td></tr> <tr> <td>2. Laboratory reports</td><td>10%</td><td>✓</td><td>✓</td><td></td><td>✓</td><td></td></tr> <tr> <td>3. Seminar report</td><td>5%</td><td>✓</td><td></td><td>✓</td><td></td><td>✓</td></tr> <tr> <td>4. Tests</td><td>20%</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td></tr> <tr> <td>5. Final examination</td><td>50%</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td></tr> <tr> <td>Total</td><td>100%</td><td colspan="5"></td></tr> </tbody> </table> <p><b>Students must pass the final examination and achieve a passing overall score / grade to pass the subject.</b></p> |                                                   |   |                        |   |   | Specific assessment methods/tasks | % weighting | Intended subject learning outcomes to be assessed |  |  |  |  | a | b | c | d | e | 1. Assignments | 15% | ✓ | ✓ | ✓ |  |  | 2. Laboratory reports | 10% | ✓ | ✓ |  | ✓ |  | 3. Seminar report | 5% | ✓ |  | ✓ |  | ✓ | 4. Tests | 20% | ✓ | ✓ | ✓ |  |  | 5. Final examination | 50% | ✓ | ✓ | ✓ |  |  | Total | 100% |  |  |  |  |  |
| Specific assessment methods/tasks                                      | % weighting                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Intended subject learning outcomes to be assessed |   |                        |   |   |                                   |             |                                                   |  |  |  |  |   |   |   |   |   |                |     |   |   |   |  |  |                       |     |   |   |  |   |  |                   |    |   |  |   |  |   |          |     |   |   |   |  |  |                      |     |   |   |   |  |  |       |      |  |  |  |  |  |
|                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | a                                                 | b | c                      | d | e |                                   |             |                                                   |  |  |  |  |   |   |   |   |   |                |     |   |   |   |  |  |                       |     |   |   |  |   |  |                   |    |   |  |   |  |   |          |     |   |   |   |  |  |                      |     |   |   |   |  |  |       |      |  |  |  |  |  |
| 1. Assignments                                                         | 15%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ✓                                                 | ✓ | ✓                      |   |   |                                   |             |                                                   |  |  |  |  |   |   |   |   |   |                |     |   |   |   |  |  |                       |     |   |   |  |   |  |                   |    |   |  |   |  |   |          |     |   |   |   |  |  |                      |     |   |   |   |  |  |       |      |  |  |  |  |  |
| 2. Laboratory reports                                                  | 10%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ✓                                                 | ✓ |                        | ✓ |   |                                   |             |                                                   |  |  |  |  |   |   |   |   |   |                |     |   |   |   |  |  |                       |     |   |   |  |   |  |                   |    |   |  |   |  |   |          |     |   |   |   |  |  |                      |     |   |   |   |  |  |       |      |  |  |  |  |  |
| 3. Seminar report                                                      | 5%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ✓                                                 |   | ✓                      |   | ✓ |                                   |             |                                                   |  |  |  |  |   |   |   |   |   |                |     |   |   |   |  |  |                       |     |   |   |  |   |  |                   |    |   |  |   |  |   |          |     |   |   |   |  |  |                      |     |   |   |   |  |  |       |      |  |  |  |  |  |
| 4. Tests                                                               | 20%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ✓                                                 | ✓ | ✓                      |   |   |                                   |             |                                                   |  |  |  |  |   |   |   |   |   |                |     |   |   |   |  |  |                       |     |   |   |  |   |  |                   |    |   |  |   |  |   |          |     |   |   |   |  |  |                      |     |   |   |   |  |  |       |      |  |  |  |  |  |
| 5. Final examination                                                   | 50%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ✓                                                 | ✓ | ✓                      |   |   |                                   |             |                                                   |  |  |  |  |   |   |   |   |   |                |     |   |   |   |  |  |                       |     |   |   |  |   |  |                   |    |   |  |   |  |   |          |     |   |   |   |  |  |                      |     |   |   |   |  |  |       |      |  |  |  |  |  |
| Total                                                                  | 100%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                   |   |                        |   |   |                                   |             |                                                   |  |  |  |  |   |   |   |   |   |                |     |   |   |   |  |  |                       |     |   |   |  |   |  |                   |    |   |  |   |  |   |          |     |   |   |   |  |  |                      |     |   |   |   |  |  |       |      |  |  |  |  |  |
| <b>Student Study Effort Expected</b>                                   | Class contact:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                   |   | Average hours per week |   |   |                                   |             |                                                   |  |  |  |  |   |   |   |   |   |                |     |   |   |   |  |  |                       |     |   |   |  |   |  |                   |    |   |  |   |  |   |          |     |   |   |   |  |  |                      |     |   |   |   |  |  |       |      |  |  |  |  |  |
|                                                                        | ▪ Lectures / Tutorials / Laboratory                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                   |   | 3 Hrs.                 |   |   |                                   |             |                                                   |  |  |  |  |   |   |   |   |   |                |     |   |   |   |  |  |                       |     |   |   |  |   |  |                   |    |   |  |   |  |   |          |     |   |   |   |  |  |                      |     |   |   |   |  |  |       |      |  |  |  |  |  |
|                                                                        | Other student study effort:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                   |   |                        |   |   |                                   |             |                                                   |  |  |  |  |   |   |   |   |   |                |     |   |   |   |  |  |                       |     |   |   |  |   |  |                   |    |   |  |   |  |   |          |     |   |   |   |  |  |                      |     |   |   |   |  |  |       |      |  |  |  |  |  |
|                                                                        | ▪ Reading and Studying                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                   |   | 4.2 Hrs.               |   |   |                                   |             |                                                   |  |  |  |  |   |   |   |   |   |                |     |   |   |   |  |  |                       |     |   |   |  |   |  |                   |    |   |  |   |  |   |          |     |   |   |   |  |  |                      |     |   |   |   |  |  |       |      |  |  |  |  |  |
|                                                                        | ▪ Completion of Assignments/Lab. Reports                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                   |   | 1.8 Hrs.               |   |   |                                   |             |                                                   |  |  |  |  |   |   |   |   |   |                |     |   |   |   |  |  |                       |     |   |   |  |   |  |                   |    |   |  |   |  |   |          |     |   |   |   |  |  |                      |     |   |   |   |  |  |       |      |  |  |  |  |  |
|                                                                        | Total student study effort                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                   |   | 9 Hrs.                 |   |   |                                   |             |                                                   |  |  |  |  |   |   |   |   |   |                |     |   |   |   |  |  |                       |     |   |   |  |   |  |                   |    |   |  |   |  |   |          |     |   |   |   |  |  |                      |     |   |   |   |  |  |       |      |  |  |  |  |  |

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| <p><b>Reading List and References</b></p> | <p>Mackenzie Davis and David Cornwell (2012), Introduction to Environmental Engineering, 5<sup>th</sup> Edition, McGraw Hill Co.</p> <p>Colin Baird (2012), Environmental Chemistry, 5<sup>th</sup> Edition, W.H. Freeman and Company.</p> <p>Sawyer, C. N., McCarty, P. L., and Parkin, G. F. (2003) Chemistry for Environmental and Engineering and Science, 5<sup>th</sup> Edition, McGraw Hill Co.</p> |
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