

### Subject Description Form

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| <b>Subject Code</b>                              | EIE6200   |
| <b>Subject Title</b>                             | Methodology for Engineering and Scientific Research   |
| <b>Credit Value</b>                              | 3   |
| <b>Level</b>                                     | 6   |
| <b>Pre-requisite / Co-requisite / Exclusion</b>  | Nil   |
| <b>Objectives</b>                                | <p>This subject aims to equip students with the methodologies necessary for conducting engineering and scientific research. The objectives of this subject include:</p> <ul style="list-style-type: none"><li>(i) To enable students to have a broad concept on the philosophy of research</li><li>(ii) To introduce students with the methods and process for the design and formulation of a research study, as well as the different types of scientific research approaches and methods</li><li>(iii) To familiarize students with the methods for validating and presenting research results</li></ul>   |
| <b>Intended Learning Outcomes</b>                | <p>Upon completion of the subject, students will be able to:</p> <ul style="list-style-type: none"><li>1. identify and select appropriate research problems;</li><li>2. formulate research objectives, analyze the problem, state hypotheses;</li><li>3. identify the safety and ethical issues in a research study;</li><li>4. identify, select appropriate research methods and develop process for conducting research;</li><li>5. appreciate published literature and write research paper; and</li><li>6. make professional presentations of research results and defend the propositions and claims.</li></ul>  |
| <b>Subject Synopsis/<br/>Indicative Syllabus</b> | <p><u>Keyword Syllabus</u></p> <p>This subject provides students with the following key topics:</p> <ul style="list-style-type: none"><li>1. Research Philosophy and Ethics in Engineering Research<br/>Overview of research philosophy and purposes such as positivism/interpretivism, significance of research in society, etc.; importance of research ethics; professional codes and policies of research ethics in engineering; ethical decision making in research; safety considerations in research; case studies.</li><li>2. Scientific Research Methods<br/>Observation and description; cause and effect; analysis and synthesis; hypothesis, deduction, induction, testing of hypothesis; system modeling; action research, design-based approach; mathematical, modelling, and numerical computations; probability, randomness and logic.</li><li>3. Conducting a Research<br/>Process for developing research plan; formulation of research problem; feasibility and significance studies; critical review of literature; design experiments and apparatus; measurement of human information, questionnaire design; quantitative vs qualitative research or mixed methods, empirical research; classification and sampling; analysis of experimental data; errors of measurement, validity, reliability, and uncertainty analysis of research findings; reporting research results.</li></ul> |

|   | <p>4. Writing and Presentation Techniques<br/>Tools for preparing research document; preparing research proposal; research paper writing and style; thesis writing and style; making oral and poster presentations.</p>   |                                   |             |  |   |   |   |  |  |   |   |   |   |   |   |   |    |   |   |  |   |   |   |                                |    |   |  |  |  |  |  |  |    |  |  |   |  |  |  |       |       |  |  |  |  |  |  |
|---|---|-----------------------------------|-------------|--|---|---|---|--|--|---|---|---|---|---|---|---|----|---|---|--|---|---|---|--------------------------------|----|---|--|--|--|--|--|--|----|--|--|---|--|--|--|-------|-------|--|--|--|--|--|--|
| <p><b>Teaching/Learning Methodology</b></p>                                   | <ul style="list-style-type: none"> <li>To help the students understand the importance of academic honesty and learn ways to ensure that the work and behavior at PolyU are acceptable, the students are required to complete the “Online Tutorial on Academic Integrity” not later than Week 5. <u>The Online Tutorial is part of the subject completion requirement. Students who fail to complete the Online Tutorial will fail this subject.</u></li> <li>Formal classroom lectures will be given to introduce the concepts in research philosophy, ethics and safety in research, scientific research methods, methodologies when conducting a research, as well as writing and presentation techniques. They support the intended learning outcome 1 to 6.</li> <li>A workshop will be given to familiarize students the tools for preparing research documents. It supports the intended learning outcome 6.</li> <li>Each student is required to complete a mini-project in which the student will select a problem of his/her interest, conduct a literature search, generate/collect research data, and finally prepare research papers. A mini-conference will be held at the end to allow the students to practice making an oral presentation of the papers they developed in the mini-project. They support the intended learning outcome 1 to 6.</li> </ul> |                                   |             |  |   |   |   |  |  |   |   |   |   |   |   |   |    |   |   |  |   |   |   |                                |    |   |  |  |  |  |  |  |    |  |  |   |  |  |  |       |       |  |  |  |  |  |  |
| <p><b>Assessment Methods in Alignment with Intended Learning Outcomes</b></p> | <p>In addition to the assessment methods below, the students are required to complete the “Online Tutorial on Academic Integrity” not later than Week 5. <u>The Online Tutorial is part of the subject completion requirement. Students who fail to complete the Online Tutorial will fail this subject.</u> This assessment method assesses the intended learning outcome 3.</p> <table border="1"> <thead> <tr> <th rowspan="2">Specific assessment methods/tasks</th> <th rowspan="2">% weighting</th> <th colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</th> </tr> <tr> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th>6</th> </tr> </thead> <tbody> <tr> <td>1. Mini-project: research proposal, research paper, oral presentation</td> <td>70</td> <td>√</td> <td>√</td> <td></td> <td>√</td> <td>√</td> <td>√</td> </tr> <tr> <td>2. Report – Impact of research</td> <td>15</td> <td>√</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3. Case study – Research Ethics in Engineering</td> <td>15</td> <td></td> <td></td> <td>√</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Total</td> <td>100 %</td> <td colspan="6"></td> </tr> </tbody> </table>  | Specific assessment methods/tasks | % weighting | Intended subject learning outcomes to be assessed (Please tick as appropriate) |   |   |   |  |  | 1 | 2 | 3 | 4 | 5 | 6 | 1. Mini-project: research proposal, research paper, oral presentation | 70 | √ | √ |  | √ | √ | √ | 2. Report – Impact of research | 15 | √ |  |  |  |  |  | 3. Case study – Research Ethics in Engineering | 15 |  |  | √ |  |  |  | Total | 100 % |  |  |  |  |  |  |
| Specific assessment methods/tasks   | % weighting   |                                   |             | Intended subject learning outcomes to be assessed (Please tick as appropriate) |   |   |   |  |  |   |   |   |   |   |   |   |    |   |   |  |   |   |   |                                |    |   |  |  |  |  |  |  |    |  |  |   |  |  |  |       |       |  |  |  |  |  |  |
|   |   | 1                                 | 2           | 3  | 4 | 5 | 6 |  |  |   |   |   |   |   |   |   |    |   |   |  |   |   |   |                                |    |   |  |  |  |  |  |  |    |  |  |   |  |  |  |       |       |  |  |  |  |  |  |
| 1. Mini-project: research proposal, research paper, oral presentation         | 70  | √                                 | √           |  | √ | √ | √ |  |  |   |   |   |   |   |   |   |    |   |   |  |   |   |   |                                |    |   |  |  |  |  |  |  |    |  |  |   |  |  |  |       |       |  |  |  |  |  |  |
| 2. Report – Impact of research  | 15  | √                                 |             |  |   |   |   |  |  |   |   |   |   |   |   |   |    |   |   |  |   |   |   |                                |    |   |  |  |  |  |  |  |    |  |  |   |  |  |  |       |       |  |  |  |  |  |  |
| 3. Case study – Research Ethics in Engineering                                | 15  |                                   |             | √  |   |   |   |  |  |   |   |   |   |   |   |   |    |   |   |  |   |   |   |                                |    |   |  |  |  |  |  |  |    |  |  |   |  |  |  |       |       |  |  |  |  |  |  |
| Total   | 100 %   |                                   |             |  |   |   |   |  |  |   |   |   |   |   |   |   |    |   |   |  |   |   |   |                                |    |   |  |  |  |  |  |  |    |  |  |   |  |  |  |       |       |  |  |  |  |  |  |

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|   | <p><u>Assessment:</u></p> <p>Continuous Assessment <span style="float: right;">100%</span></p> <p>Principal course assignments will include the following:</p> <ul style="list-style-type: none"> <li>• Students will go through the whole process of a research project in a mini-project. The problem can be a well known one and should be of student's interest. Student submissions for this mini-project may include <ul style="list-style-type: none"> <li>○ a research proposal</li> <li>○ the final research paper</li> </ul> <p>Students also need to demonstrate they can use the tools taught in the class to prepare the research paper.</p> </li> <li>• Students will participate in a mini-conference in which students will make an oral presentation of the research papers they developed in the mini-project.</li> <li>• Students will go through a critical analysis of the research they are carrying out to identify the significance in their project. Students are required to submit a report.</li> <li>• Students will conduct a case study on engineering ethics and present the details to classmates.</li> </ul> |                 |
| <p><b>Student Study Effort Expected</b></p> | <p><b>Class contact:</b></p>  |                 |
|   | <ul style="list-style-type: none"> <li>▪ Lecture</li> </ul>   | <p>20 Hours</p> |
|   | <ul style="list-style-type: none"> <li>▪ Class activity</li> </ul>  | <p>19 Hours</p> |
|   | <p><b>Other student study effort:</b></p>   |                 |
|   | <ul style="list-style-type: none"> <li>▪ Self study / Mini-project</li> </ul>   | <p>66 Hours</p> |
|   | <p><b>Total student study effort</b></p>  |                 |
| <p><b>Reading List and References</b></p>   | <p><b>Indicative Reading</b></p> <ol style="list-style-type: none"> <li>1. Kristin Shrader-Frechette, Ethics of Scientific Research, Lanham, Md.: Rowman &amp; Littlefield, 1994.</li> <li>2. E. Bright Wilson, Jr., An Introduction to Scientific Research, New York: Dover Publications, 1990.</li> <li>3. Kenneth S. Bordens and Bruce B. Abbott, Research Design and Methods - A Process Approach, 8<sup>th</sup> Edition, McGraw Hill, 2008.</li> <li>4. John W. Creswell, Research Design – Qualitative, Quantitative, and Mixed Methods Approaches, SAGE, 2009.</li> <li>5. John W. Creswell, Dr. Vicki L. Plano Clark, Designing and Conducting Mixed Methods Research, SAGE, 2008.</li> <li>6. W. James Bradley and Kurt C. Schaefer, The Uses and Misuses of Data and Models: The Mathematization of the Human Science, SAGA Publications, Inc., 1998.</li> <li>7. Mark L. Mitchell and Janina M. Jolley, Research Design Explained, 6<sup>th</sup> Edition, Thomson Wadsworth, 2007.</li> <li>8. John D. Sterman, Business dynamics: Systems thinking and modeling for a complex world, McGraw-Hill, 2000.</li> </ol>              |                 |