# Subject Description Form

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| **Subject Code** | LSGI4613 |
| **Subject Title** | **Geophysical Imaging & Diagnosis of Utilities** |
| **Credit Value** | 3 |
| **Level** | 4 |
| **Pre-requisite** | LSGI2652 Utility Surveying and Management |
| **Objectives** | The objectives of this subject are:<br><br>• To provide an understanding of the background, fundamental principles and geophysical survey technologies applied in imaging and diagnosis to assess the service conditions of underground utility installations.<br>• To provide an understanding of utility malfunction due to design, network, local structural and material failure.<br>• To enable students become proficient for the use of traditional and modern underground utility imaging and diagnostic equipment.<br>• To ensure the proper application of principles and methods when carrying out underground utility imaging and diagnostic tasks.<br><br>Students' communication skill, leadership and cooperative attitudes of work with others will be developed through group field activities. |
| **Intended Learning Outcomes** | Upon completion of the subject, students will be able to:<br><br>1. Describe the functions, operation, limitations and sources of error of geophysical survey of underground utilities (L3).<br>2. Select different surveying imaging and diagnostic technologies based on the task requirements (L3)<br>3. Describe how a geophysical imaging and diagnostic task is established for different utility types and material types (L2).<br>4. Understand the reasons, processes and consequences of design, network, structural and material failure. (L2)<br>5. Apply the geophysical survey, imaging and diagnostic technologies and data processing technologies to the proper long-term care of underground utilities and advise the stakeholder departments and companies of potential maintenance problems (L3).<br>6. Correctly summarize, integrate and apply the learned technologies to the Group Utility Project (L4). |

**Subject Synopsis/ Indicative Syllabus**

**A. Utility design and network failure, local structural and material failure**

Causes, processes and consequence of malfunction of utility system and materials due to design, network, structural failure (landslide, ground collapse, settlement), material failure (leakage, stress and strain, cracks, plastic deformation, metal fatigue and corrosion, thermal regulation and control as well as their functional limits under different environmental conditions).

**B. Flow and pressure monitoring**

Principles and instrumentation of flow velocity and flow depth measurement in zoned basins, catchments and district metering areas, scattergraph interpretation, rainfall dependent infiltration and inflow.

**C. Advanced utility Surveying, monitoring and data processing**

Multi-dimensional imaging by Ground penetrating radar, acoustic noise logging, leak noise correlation methods, infrared thermography, CCTV inspection, pipe pigging, different sources of error and noise, de-noise techniques, calibration of instrument, error and uncertainty analysis, sampling theorem, Fourier analysis. A field camp will be offered.

**Teaching/Learning Methodology**

| Lecture | Tutorial/ practical | Experiment | Field survey | Guest lecture | Site visit | On-line learning |
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| ✓ | ✓ | ✓ | ✓ | | | ✓ |

**Assessment Methods in Alignment with Intended Learning Outcomes**

| Specific assessment methods/tasks | % weighting | Intended subject learning outcomes to be assessed (Please tick as appropriate) | | | | | |
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| | | 1 | 2 | 3 | 4 | 5 | 6 |
| 1. Blind test in lab | 20 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2. Blind test in survey camp | 30 | | ✓ | | ✓ | ✓ | ✓ |
| 2. Examination | 50 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Total | 100 % | | | | | | |

Continuous assessment consists of two components: of blind tests in lab and in field camp. The tests will be used to train students be skillful in using various utility surveying instruments for diagnosis of various underground utilities problems. The lab and the field camp are controlled environment to

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| | assess their knowledge on the principles of different instruments, applicability and limitations under different conditions. | |
| **Student Study Effort Expected** | Class contact: | |
| | ▪ Lectures | 26 Hrs. |
| | ▪ Tutorial/practical | 26 Hrs. |
| | ▪ Field Camp | 40 Hrs. |
| | Other student study effort: | |
| | ▪ Self-study, reading and revision | 60 Hrs. |
| | Total student study effort | 152 Hrs. |
| **Reading List and References** | 1. Mark E. Everett (2013) *Near-surface applied geophysics*, Cambridge University Press.<br>2. ADS Environmental Services, Collections of Scattergraph Papers (http://www.adsenv.com/default.aspx?id=2481).<br>3. N.R. Morgenstern & Geotechnical Engineering Office (2000) *GEO report no. 103: Report on the Kwun Lung Lau Landslide of 23 July 1994*.<br>4. Goodman, D. (2012), *GPR-SLICE V7.0 user's manual*.<br>5. Mahesh L. Chugani, Abhay R. Samant, Michael Cerna (1998) *LabVIEW signal processing*, Upper Saddle River, NJ: Prentice Hall PTR.<br>6. Manfred Drosg (2007). *Dealing with uncertainties: a guide to error analysis*, Springer.<br>7. P.V. Xavier Maldague and O. M. Patrick (Ed.) (2001) *Infrared and thermal testing / technical editor*, *Columbus*, OH : American Society for Nondestructive Testing.<br>8. Department of Land Surveying and Geo-Informatics (LSGI) (2019), *Specifications 1,1 Pipe Cable Locating/Electromagnetic Locating*.<br>9. Department of Land Surveying and Geo-Informatics (LSGI) (2019) *Specification 1,2 Ground Penetrating Radar (GPR)*.<br>10. Department of Land Surveying and Geo-Informatics (LSGI) (2021) *Specification 1,3 Laser Scanning Survey (LiDAR)*.<br>11. Department of Land Surveying and Geo-Informatics (LSGI) (2021) *Specification 2,1 Visual Inspection*.<br>12. Department of Land Surveying and Geo-Informatics (LSGI) (2019) *Specification 2,2 Acoustic Leak Detection (ALD)*. | |