Subject Description Form

Subject Code	**BSE4724**
Subject Title	**Engineering Experimental Design**
Credit Value	3
Level	4
Pre-requisite Co-requisite Exclusion	Nil Nil Nil
Objectives	This subject is intended to allow students to acquire basic knowledge that an engineer should have in order to successfully design experiments and measurement systems. Focuses are also put on data acquisition systems, common statistics techniques and experimental uncertainty analysis. Guidelines for planning and documenting experiments are included in the subject.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) appreciate the basic principles in setting up / preparing experiments, the data acquisition and the error analysis; b) understand common engineering measurement systems, c) understand common data analysis technique in engineering and choose appropriate analysis methods.
Subject Synopsis/ Indicative Syllabus	**Measurement systems and data acquisition**: Generalized measurement system, validity of measurement, measurement errors and calibration, dynamic measurement, systems with electrical signals, computerized data acquisition systems, data sampling technique, dimensions and units, laws of similarity and their applications. Dynamic behaviour of measurement systems. **Experimental data analysis**: statistical approach including central tendency, dispersion, probability, parameter estimation, outliners, correlations, frequency analysis. **Experimental Uncertainty analysis :** Uncertainty propagation, bias, sources of elemental error, single- and multi- sample measurements, digital data acquisition systems, introduction to multi-order uncertainty analysis. **Measurements of common parameters** : solid mechanics, fluid flows, psychrometric parameters, pollutants, harmonics and electrical parameters. **Planning and documenting experiments** : problem definition, experiment design and preparation, data gathering and analysis, interpretation of data and reporting, dimensional analysis, uncertainty analysis, shakedown tests, sequencing and test matrix, scheduling, design review and documentation of experimental activities.
Teaching/Learning Methodology	There will be 8 lectures/seminars to illustrate the fundamental principles, demonstrate the application of the theory with examples. There will be 2 tutorial sessions, during which students are expected to work on solutions of real-life problems via discussion with lecturers and among themselves. Students will be required to do assigned-readings, particularly on the fundamentals, before attending lecturers and tutorials. The assigned readings will be detailed in the teaching scheme to be distributed to students at the beginning of the Semester.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c			
In class test	20	✓					
Written exam	40	✓	✓	✓			
Experimental design project	40	✓	✓	✓			
Total	100%						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

a) Building Services Engineers are expected to undertake on-site measurements, sophisticated quantitative analysis and design calculations, for problem identification and design optimization purposes.

b) The written test and exam serve to examine the students' learning outcome in the problem analysis and solving capabilities.

c) The mini design project is an essential component as it tests the students' understanding on the experimental design principles.

Student Study Effort Expected

Class contact:	
▪ Lectures / seminars	24 Hrs.
▪ Tutorials	6 Hrs.
▪ In class written test	3 Hrs.
▪ Project presentation	6 Hrs.
Other student study effort:	
▪ Reading and working on given exercises and tasks	31 Hrs.
▪ Experimental design group project	50 Hrs.
Total student study effort	120 Hrs.

Reading List and References

TEXTBOOK

A.J. Wheeler, A.R.Ganji, Introduction to engineering experimentation, NJ, Prentice Hall, 2010.

OTHER REFERENCE BOOKS

Gibbings JC, Dimensional analysis, London, Springer, 2011

D.C. Baird, Experimentation: an introduction to measurement theory and experiment design., NJ, Prentice Hall, 1962

H.W. Coleman, Steele, W.G, Experimentation, Validation, and Uncertainty Analysis for Engineers, NY, Wiley, 2009.