Subject Description Form

Subject Code	LSGI3242A
Subject Title	**Digital Terrain Modelling**
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To provide an understanding of the fundamental principles and techniques of digital terrain modelling and visualization; 2. To enable students become proficient in the use of conventional and modern techniques for digital terrain modelling and visualization; and 3. To enable students to properly apply cartographic principles and methods to practical terrain modelling and visualization problems. 4. To enable students to combine building objects and digital terrain modelling (DTM) for 3D visualization and analysis 5. An introduction to 3-D physical-based rendering of DTM and remote sensing models.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: 1. Define various types of terrain modelling techniques (L2) 2. Explain the triangulation and interpolation techniques (L3) 3. Interpret various types of terrain parameters (L3) 4. Apply different modelling techniques for a given set of data; (L4) 5. Critically analyze DTM products (L4) 6. Integrate 3D model with DTM for 3D visualization (L3)
Subject Synopsis/ Indicative Syllabus	**A. DTM data structure** Data sources; DTM data models (contour, raster, grid, TIN); DTM file and table management; Conversion between data models; Gridding **B. Interpolation techniques** Classification of interpolation methods; Polynomial representation; Local interpolation method; Trend surface analysis; Point based weighted average; Moving average **C. Delaunay triangulation** Empty circumcircle principle; Equiangularity; Static and dynamic triangulation; Constrained triangulation. **D. Terrain descriptors** Qualitative descriptors; quantitative descriptors (roughness vector, semi-variance, spatial autocorrelation);

E. Sampling
Nyquist-Shannon theorem and optimal frequency; Cut-off frequency; Selective sampling; Regular sampling; Progressive sampling.

F. Quality control
Data source errors; Noise filtering; gross error detection.

G. DTM analysis
Geometrical parameters; Morphological parameters (slope, aspect, curvature); Morphometric classes; Hydrological parameters (flow direction and accumulation).

H. Contouring
Contouring from grid and TIN; Raster-based contouring.

I. Voronoi diagram
Delaunay triangulation and Voronoi diagram; Voronoi diagram in raster mode; Skeletonisation; Application to triangulation of contour data.

J. 3D and DTM integration
3D vs DTM, 3D visualization

Teaching/Learning Methodology

Students will gain the theories and methodologies in lectures. Lectures will address algorithmic aspects of DTM construction and analysis. Students will then gain practical experience through tutorial sessions and individual work. Practical work will mainly consist in the implementation and assessment of techniques seen in the lecture.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		1	2	3	4	5	6
1. Lab assignments	50%	✓	✓	✓	✓	✓	✓
2. Quizzes	10%	✓	✓	✓			
3. Examination	40%	✓	✓	✓	✓	✓	✓
Total	100%						

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

Understanding of basic concepts and knowledge is assessed in two short quizzes taken during the lectures. Three lab assignments are given to students. Each lab assignment consists of a two to three week assignment where students have to implement an algorithm or to apply and assess a set of methods on terrain data. The final exam will consist of one part with short questions assessing their understanding of basic concepts (outcomes 1 to 3) and one part with open questions assessing outcomes 4 and 5. In order to get a pass, students need to have an overall pass.

Student Study Effort Expected	Class contact:	
	▪ Lectures	26Hrs.
	▪ Lab sessions	13Hrs.
	Other student study effort:	
	▪ Preparation for lectures and quizzes	20Hrs.
	▪ Lab assignments	50Hrs.
	Total student study effort	109Hrs.
Reading List and References	Dong, P., & Chen, Q. (2017). LiDAR remote sensing and applications. CRC Press. 220 pp. El-Sheimy, N., Valeo, C., & Habib, A. (2005). Digital terrain modeling: acquisition, manipulation, and applications. Artech House. 270 pp. Li, Z., Zhu, C., & Gold, C. (2004). Digital terrain modeling: principles and methodology. CRC Press. 318 pp. Maune, D.F. and Nayegandhi, A. (2019). Digital elevation model technologies and applications - The DEM users manual. 3rd Edition, American Society of Photogrammetry and Remote Sensing.	