CE313 Engineering Geomatics

Co-ordinator: Dr W.Y. Ochieng (Room 614), w.ochieng@imperial.ac.uk

Status: Elective

Lecturers:	Dr W.Y. Ochieng (WYO) (Room 614) Dr J.J. Bommer (JJB) (Room 324) Dr C.J. Onof (CJO) (Room 410)
Structure:	50 hours of lectures, tutorials & practicals with associated coursework.
Links:	Surveying and Surveying Field Trip Module (CE112)

Aims

To enable students to acquire theoretical knowledge and practical skills required in the management of spatial information for civil and environmental engineering projects.

SYLLABUS

Introduction to geomatics (2 hours) WYO
Definitions; types of spatial data; the data management process; branches of geomatics, professional organisations; the role of the geomatician in civil and environmental engineering projects; recent advances in geomatics.

Spatial reference systems (3 hours) WYO
Coordinate systems; map projections.

Conventional data capture techniques and instrumentation (3 hours) WYO
Horizontal distance measurement - tapes, stadia tacheomtry, EDMs; vertical distance measurement – the level and levelling; angle measurement – the surveyor's theodolite; integrated systems – the total station; introduction to data processing.

Mathematical Optimisation (4 hours) CJO
Error theory, Least squares optimisation; statistical testing.

Survey Adjustment, Error Analysis and Quality Control (3 hours) WYO
Least squares applied to position fixing; analysis and design of control surveys; deformation monitoring.

GPS Surveying (4 hours) WYO
Basic principles of geodesy; satellite positioning principles, observables and algorithms; practical applications.

Geographical Information Systems (GIS) (3 hours) WYO
Basic concepts; data sources and instrumentation; software; application in civil engineering

Photogrammetry and Remote sensing (2 hours) WYO
Definitions; basic principles; instrumentation; data acquisition process; mathematical models; engineering applications.

Setting out/Dimensional control (3 hours) WYO
Basic setting out procedures; setting out of buildings; controlling verticality; route location; responsibility of the setting out engineer.

Example areas of application of GPS and GIS (4 hours) JJB
Geodynamics; regional and global geophysics; earthquake risk analysis; protection of water distribution systems in earthquake regions.

Tutorials, Demonstrations and external lectures
Use of GIS software and hardware; GPS equipment and software; Demonstration of the use of photogrammetric equipment for engineering applications; Demonstration of the process of acquiring positioning data from remotely sensed images; External lectures and presentations on relevant topics.

Coursework and submission dates
Coursework exercises will be given covering theoretical and practical aspects of the module.

- Exercise 1 on the basic principles of engineering geomatics and spatial reference systems. (*Workload = 6 hours; Submission date = 19/11/2004; Assessment = Maximum 5 points*)
- Exercise 2 on mathematical optimisation and GPS surveying. (*Workload = 8 hours; Submission date = 16/12/2004; Assessment = Maximum 8 points*).
- Exercise 3 on the use GIS for engineering applications (*Workload = 8 hours; Submission dates = 10/02/2005; Assessment = Maximum 8 points*).
- Exercise 4 on capture and processing of engineering survey data using total stations, GPS and conventional levelling (*Workload = 8 hours; Submission dates = 14/03/2005; Assessment = Maximum 15 points*)

Assessment
One 3-hour examination (64% module mark) & coursework assignments (36% module mark)

Recommended Textbooks/Reading

- ALLAN, A L. Practical Surveying and Computations. *Laxstons, Latest Edition*.
- ANDERSON, JM AND MIKHAIL EM. 1998. Surveying. *McGrawHill, 7th Edition.*
- ARONOFF S. Goegraphic Information Systems: A Management Perspective. *WDL Publications, Canada.*
- BANNISTER A AND RAYMOND S. Surveying. *Longman Scientific & Technical, Latest Edition.*
- CROSS, P A. Advanced Least Squares Applied to Position Fixing.
- Journal of the Institute of Navigation (USA)
- Journal of the Royal Institute of Navigation (UK)
- Journal of Geodesy.
- Journal of the Institute of Civil Engineering Surveyors (ICES).
- Journal of the Institute of Civil Engineers (ICE).
- JESB (Joint Engineering Survey Board). Standards for Setting Out in Civil Engineering.
- The GPS Solutions journal
- IRVINE W. 1995. Surveying for construction. *MacGraw-Hill Book Company, 4th edition.*
- MATHER P M. Computer Processing of Remotely Sensed Images: An Introduction. *John Wiley and Sons.*
- Proceedings of the Institute of Navigation (USA).

- SEEBER G. 1993. Satellite Geodesy-Foundations, Methods and Applications. *Walter de Gruyter, Latest edition.*
- UREN AND PRICE. Surveying for Engineers. *Macmillan, Latest Edition.*

Learning Outcomes

- describe the role of geomatics in civil and environmental engineering.
- describe the spatial reference systems used in geomatics.
- demonstrate an understanding of mathematical optimisation and its use in Geomatics.
- plan, design, and establish a high precision survey network for deformation monitoring.
- plan, design, execute and check a survey for the creation of a digital terrain model (DTM) for highway design.
- demonstrate an understanding of the mathematical models and surveying techniques used with satellite positioning systems.
- describe the basic elements of photogrammetry (analytical and digital) and its engineering applications.
- describe the basic elements of Geographical Informations Systems (GIS) and their engineering applications.
- describe the basic elements of remote sensing and its engineering applications.
- demonstrate practical skills in the use of satellite positioning equipment and software.
- demonstrate practical skills in the use of Total Stations and Electronic levels for direct data acquisition and processing in the field.
- demonstrate practical skills in the use of GIS facilities for engineering applications.