York University
Faculty of Science and Engineering

SC/EATS 3640 4.0 and SC/ENG 3140 4.0

Geodetic Surveys

Winter 2009

Course Director

Jian-Guo Wang, Dr.-Ing., P.Eng.
Phone: 416-736-2100 ext. 20761
Fax: 416-650-8135
E-mail: jgwang@yorku.ca
Office: CSE Bldg 1012T

Teaching Assistant

Nilesh Gopaul
Office: TBD
Phone: TBD
Email: nileshgo@yorku.ca

Lectures

Tuesdays, 15:00 – 18:00 (3:00p.m. – 6:00p.m.)
The Engineering Lab (Petrie Sci. and Eng. Building, Room 020)

Laboratory exercises

Fridays, 09:00-12:00.
The Engineering Lab (Petrie Sci. and Eng. Building, Room 020)

Office Hours

Tuesday, 10:00 – 13:00 (10:00a.m. – 1:00p.m.)
And per appointment

Assessment

Laboratories	45%
Mid-term test	15%
Participation	5%
Final Exam	35%

Attension: Students, who miss maximum 3 lab assignments for any reason, will automatically prevent from passing this course without exception.

Grade System

≥90%	A+
80-89%	A
75-79%	B+
70-74%	B
65-69%	C+
60-64%	C
55-59%	D+
50-54%	D
40-49%	E
<39%	F

GENERAL COURSE INFORMATION

1. Objectives

- Familiarization with high precision survey instrument systems.
- Gain knowledge and skills in testing and calibrating of survey instruments according to standards and specifications.
- Establishing high precision geodetic control for special purpose engineering projects.
- Applying geodetic theory in high precision monitoring networks.
- Acquiring knowledge and skills on the establishment and measurement of special purpose monitoring networks for a variety of engineering applications.
- Developing skills in data collection, processing, analysis and interpretation via advanced and complex calculations and computer programming.

2. Format

Since every individual responds to different stimuli in his or her learning process, the presentation of the material will be done in a variety of ways. All of them will require work on your part to be effective. We will take a participative approach to learning. This means that faculty and students learn **together** by doing. We will learn **with** each other and **from** each other. **Therefore, we are all responsible for being prepared for class:**

- Lecture sessions will be conducted in form of discussion and participation. Students are required to participate actively, and design and solve problems by synthesizing knowledge, experience and skills from previous courses.
- The course will be closely related and will be running parallel to SC/ENG3130 4.0 "*Analysis of overdetermined systems*."
- Each session will normally commence with a brief review of the concepts treated previously. New subject(s) will be presented immediately after the review, according to the tentative lecture schedule provided in this handout. **Participation** is an essential element of learning: It will be **encouraged** and **assessed**.
- All sessions will based on, but not limited to the advanced topics of the textbook. Technical papers will also be supplied by the instructor for further studies. The students will be required to actively search relevant literature to further their knowledge.

3. Laboratory and field exercises

- Laboratories are most essential for the development of skills and experience. They will comprise a variety of activities that are usually required in the design, planning, execution, analysis and interpretation of data, and preparation of comprehensive reports.
- Laboratory exercises will be conducted in the lab and in the field depending on weather conditions.
- Laboratory reports will have clear due dates. You are expected to describe in detail methodologies, data processing and analysis, and results and hand in reports and developed software, where applicable.
- Participation in all laboratory exercises is **mandatory**.
- Grades for late laboratory reports will be decreased by 20% per day for each day overdue. Late lab reports must be handed in personally to your TA.

4. Getting feedback on your progress

Feedback on your progress will be provided in four different ways:

- Each class session should give you a fair idea how well you have understood the relevant material.
- Laboratory exercises: You will be asked to execute all of the mandatory laboratory exercises, write reports, solve specific computational problems, perform statistical testing and evaluation of observations and solutions and design specific auxiliary equipment of high precision surveys. Your participation is essential and will be assessed.
- Mid-term test.
- Final exam.

5. Announcements

Announcements and information related to the course, such as special lectures, class cancellations, change of due dates, professional activities, Internet links, and others will be emailed to the students. Please check regularly for up-to-date announcements and information.

ACADEMIC INTEGRITY

All students should take the time to acquaint themselves with the university's policy concerning academic integrity in courses. Cheating, plagiarsing amd making unauthorized multiple submissions of academic assignments are not allowed. You are all advised to read about this at http:/www.yorku.ca/academicintegrity ('For students' session), and to complete the Academic integrity tutorial at http:/www.yourku.ca/tutorial/academic integrity/. You should print the results page of your successful quiz and keep it for verification if asked.

Ethical behaviour must be observed at all times.

SAFETY IN LAB AND FIELD

No Job is so important and no service so urgent that we cannot take time to perform our work safety. The following is not intended to be an all-inclusive capsule of safety requirements.

- Students comply with all safety regulations, policies of York University.
- Wear personal protective equipment in all designated areas or when otherwise directed to do so.
- Immediately report to TA or course Director if any safety incident occurs or may occur.
- Each individual in lab or in field has the responsibility and obligation to the other group members to work safely. If one sees another one perform an unsafe act, they should call this to the other person's attention, whether the unsafe act affects only the individual or the whole team.
- The equipment used has the potential to become very hazardous objects and must be properly secured for travel.
- The survey instruments used should be protected from any potential damage.

COURSE OUTLINE

1. Modern survey instruments – Testing and calibration
2. EDM principles and errors
3. Theodolites – principles, methodologies, errors, filed observation procedures.
4. Total station systems.
5. High precision levelling – methodologies, errors, filed observation procedures.
6. Height systems.
7. GPS basics, filed observation and data processing.
8. Geodetic networks.
9. Engineering surveys.
10. Optimal design.

TEXT BOOKS

1. Anderson, M.J., and E.M. Mikhail, (1998). Surveying: Theory and Practice. McGraw-Hill, (7^{th} Edition).
2. Wang, Jian-Guo (2009): Geodetic Surveys, Lecture Notes, Department of Earth and Space Science and Engineering, York University, revised 2007.
3. Vaníček P., and E. Krakiwsky (1986). Geodesy: The Concepts. North Holland, Amsterdam (2^{nd} Edition).

SUGGESTED REFERENCES

1. El-Rabbany, A. (2002). Introduction to GPS, the Global Positioning System. Artech House, Boston.
2. Kavanagh, B.F., (2003). Surveying Principles and Applications. Prentice Hall, New Jersey (6^{th} Edition).
3. Leick, A, (1995). GPS Satellite Surveying. John Wiley, New York (2^{nd} Edition).
4. Ghilani, C.D. and Wolf, P.R. (2006), Adjustment Computations: - Spatial Data Analysis, John Wiley & Sons (4th edition), 2006.
5. Mikhail, E.D., and G. Gracie, (1981), Analysis & Adjustment of Survey Measurements, Van Nostrand Reinhold.
6. Wolf, P.R., and C.D. Ghilani, (2002). Elementary Surveying. An Introduction to Geomatics. Prentice Hall, New Jersey (10^{th} Edition).
7. Research papers provided by the instructor.

TENTATIVE CLASS SCHEDULE

Winter Class Start: Wendesday, March 4, 2009
Winter Class End: May 21, 2009
Reading Week: Cancelled

Date		***Subject*** *(Numbers in parentheses refer to sections of the textbook #1 above)*
March	*10*	**Introduction** – Course outline and requirements. **Modern survey instruments** – Instrument handling and care (3.10), need for testing and adjustment of equipment (3.11). **Distance measurements with tapes**: Systematic errors, corrections (4.13–4.26) and other errors.
	17	**EDM (Electromagnetic Distance Measurement)**: principles and classification (4.27– 4.32), and systematic errors (4.38).
	24	**EDM:** Non-linearity in EDM; tests and calibration (4.39– 4.42) and EDM distance reductions (4.43–4.48).
	31	**Vertical Control**: Curvature & Refraction (5.2), precise levelling instruments, their errors, calibration, field observation and specification (5.46 - 5.54), Trig levelling, the EDM trig. Levelling and barometric levelling (5.1–5.6 and 5.55–5.56).
April	*07*	**Vertical Control**: Height systems, profile levelling (5.43 – 5.45) and reciprocal levelling (5.54), data processing (5.39, 5.40, 5.42, 5.57, 5.58 and 5.59).
	14	**Horizontal control**: Wild Precise Theodolites, Zeiss Theo Theo 010, Electrical Digital Theodolites, Measurement of vertical angles, Instrument Errors, testing and adjustment (6.1 – 6.44).
	21	**Horizontal control**: Instrument Errors (cont'd), Field Procedures, Total station systems (716 – 7.21) and ECDS.
	28	**GPS and Its Applications (12.1 – 12.15)**: GPS, observation methods, errors, single point positioning & DOPs.
May	*05*	**GPS and Its Applications:** DGPS, Receiver Testing, Observation Planning and data processing.
	12	**Geodetic Projects:** Generals, Network Design and software-aided Network design, pre-analysis, Practical Project - The Öresund Fixed Link between Denmark and Sweden
	19	**Geodetic Projects:** Practical Projects (continued), Different Engineering applications.

LABORATORY AND FIELD WORK
TENTATIVE SCHEDULE

Date	*Subject*
March 06	no lab performed, time reserved for Good Friday week
March 13	Lab#1: EDM Zero error determination on unknown and known baseline and EDM scale error using a known baseline.
March 20	Lab#2: EDM cyclic error determination.
March 27	Lab#3: Determination of the collimation error of precise levels.
April 03	Lab#4: High precision Levelling.
April 6~9 Week	Lab#5: Theodolite Testing and Adjustment. (time from March 06, 2009)
April 17	Lab#6: Total Station TC 1800 Testing and Operation .
April 24	Lab#7: GPS Observation/Data Processing.
May 01	Lab#7: continued.
May 08	Lab#8: Network Design/Accuracy Pre-analysis
May 15	Lab#9: Small Scale 3D Engineering Network Adjustment