

ASTRONOMY EDUCATION IN GEOMATICS

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Abstract: Traditionally, geomatics activities deal with determining precise azimuth, positioning and timing. The dependency on astronomical techniques for carrying out such practices has been well understood. However, with the availability of space-based positioning, navigation and timing (PNT) technologies especially the United States' Global Positioning System (GPS), the Russian's GLObal NAVigation Satellite System (GLONASS), and other Global Navigation Satellite Systems (GNSS), most of the astronomical tasks in geomatics practices have been taken over by the emerging GNSS technologies. Because of that, astronomy is seen has no longer role to play and thus should be discarded in the present geomatics curriculum. This view is misleading. In fact, astronomy has continuous role to play even in the space based era. Astronomy in geomatics education is vital for at least two reasons: first, it provides the basic knowledge of space based technologies, and second, it enhances the fundamental studies in Islamic astronomy as part of human capital development in Malaysia. This paper overviews the astronomy in geomatics education focusing the syllabus in geomatics curriculum, its learning and teaching activities at Universiti Teknologi Malaysia (UTM), Johor Bahru, Malaysia.

Keywords: Astronomy Education, Geomatic Engineering, Islamic Astronomy

1.0 Introduction

Geomatics especially Geomatic Engineering, as officially known in Universiti Teknologi Malaysia, is one of the professional undergraduate course. Traditionally, geomatics activities deal with determining precise azimuth, positioning and timing. The dependency on astronomical techniques for carrying out such practices has been well understood. However, with the availability of space-based positioning, navigation and timing (PNT) technologies especially the United States' Global Positioning System (GPS), the Russian's GLObal NAVigation Satellite System (GLONASS), and other Global Navigation Satellite Systems (GNSS), most of the astronomical tasks in geomatics practices have been taken over by the emerging GNSS technologies.

Because of that, astronomy is seen has no longer role to play and thus should be discarded in the present geomatics curriculum. This view is very misleading. In fact, astronomy has continuous role to play even in the space based era. Astronomy in geomatics education is vital for at least two reasons: first, it provides the basic knowledge

of space based technologies, and second, it enhances the fundamental studies in Islamic astronomy as part of human capital development in Malaysia.

This paper overviews the astronomy in geomatics education focusing the syllabus in geomatics curriculum, its learning and teaching activities at Universiti Teknologi Malaysia (UTM), Johor Bahru, Malaysia.

2.0 Astronomy Subjects In Recent Geomatic Engineering Curriculum At UTM

The overview made by Konecny (2002) perhaps highlighting the most recent curriculum of geomatics course conducted in many universities and higher institutions in the world including at UTM. Figure 1 illustrates the contents of geomatics education course.

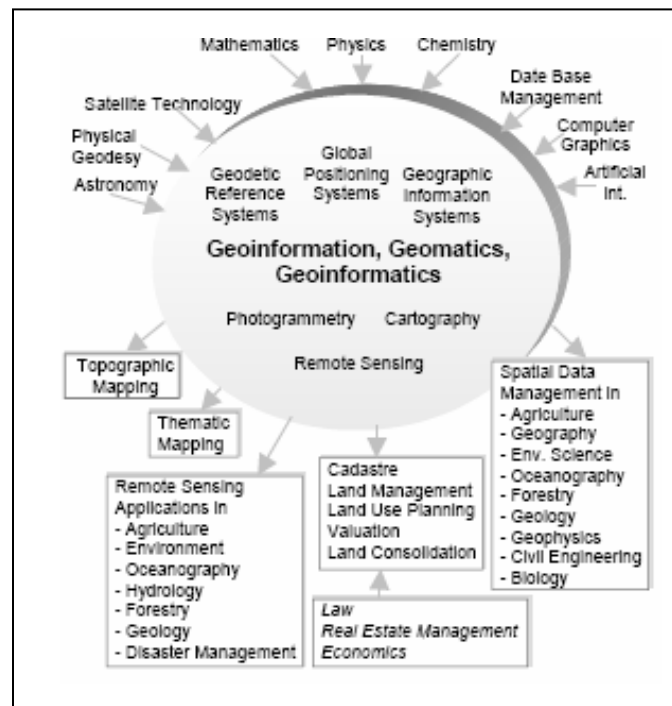


Figure 1: The curriculum of present geomatics in most universities in the world
(source: Konecny, 2002)

It clears that astronomy is one of the important background theoretical subjects to support geomatics course. It is as important as mathematics, physics, satellite technology, and others in the group. In fact, the inclusion of satellite technology in the similar group is to show that the astronomy subject going along with the technology, not vice versa.

The undergraduate geomatic engineering curriculum at UTM is closely similar to the content except the chemistry is not in. Astronomy is taught in the subject of **Field Astronomy** taken compulsorily at the second semester of eight semesters (Department of Geomatic Engineering, 2007). The objectives of the subject of field astronomy are

basically to provide the students with fundamental knowledge of field astronomy and to expose the students with basic skill in carrying out astronomical observations for determining azimuth, latitude as well as longitude to be used in surveying practices such as cadastral and geodetic surveyings. Table 1 shown the syllabus of the field astronomy.

Table 1: Field Astronomy Syllabus
(source: Department of Geomatic Engineering, 2007)

Three credit hours	Introduction, The role of astronomy in geomatics, Celestial concept, Kepler's laws of the motion of celestial bodies; Astronomical coordinates systems: Time systems, Sidereal and solar systems, Sun observation for azimuth determination; star observation for the determination of latitude and longitude of a survey station; observational errors.
Lecture (two hours per week):	
Practical: (four hours per week):	Sun observation for azimuth determination, star observation for latitude and longitude determination.

3.0 Astronomy As An Elective Subject : Islamic Astronomy

Astronomy is considered as the queen of sciences which has attracted human interest from the the earliest time. According to Mohammad Illyas,(1996), astronomy presented a special challenge to the Muslims. Thus, it is absolutely necessary to master and further develop the field to meet the daily needs of the faithful by determining the time (prayer), direction (*Qiblah*) and calendrical dates (*Taqwim*). Indeed, perhaps no other religious community interacts with, and depend upon, astronomy to such an extent as the Muslims do. That was why, astronomy received such special treatment from Muslims scientists and the State leaders during the golden era of Islamic civilization, when educating and advancement of astronomy was considered a high priority and *fard-kifayah* (a collective duty).

Furthermore, historical evidences show that the development of any field of studies including the astronomy was closely related to the development of the human civilization at the time. The Islamic history, for example, showed that the excellence development in the Islamic astronomy in the past was the result of excellence development of sciences among the Muslim communities at the time. In the Islamic science's perspective, all human activities including teaching, learning, research as well disseminating of knowledge are carried out in order to achieve a single 'noble' aim that is to get the pleasure of God. The noble aim comes out as a result of true understanding of the verse in the Quran which means:

"The fact is that only those of His servants, who possess knowledge, fear Allah..."
(*Fatir: verse 28*)

Therefore, most of the past Islamic astronomy scholars were the persons who had excellence in attitude and behavior, not materialistic, full of dedication on work, very humble, passionate, and patience in carried out responsibilities put on them. But now we observe different scenario. In realizing the present scenario, we need to increase our efforts toward bringing up the status of our scholarships through astronomy education and research. Based on that philosophy, as start, we at the Department of Geomatic Engineering successfully offered the Islamic astronomy subject as an elective subject for our graduates since 1997. The detail about the Islamic astronomy subject as in Table 2:

Table 2: The syllabus of Islamic Astronomy
(source: Department of Geomatic Engineering, 2007)

Pre requisite	Students must attend and pass the Field Astronomy taken in the second semester
Credit	3(2 hour lectures plus 2 hourrs tutorial per week
Assessment Methodology	Individual assignment, Test, Field work and Final exam
Course content	An introduction to the subject, the Islamic practices in Malaysia and in the world especially in the Islamic worlds; The determination of Qiblah: Related Islamic jurisprudence and technical aspects, contemporary issues; The determination of Islamic daily prayer times: Related Islamic jurisprudence and technical aspects, contemporary issues; The establishment of National Islamic calendar: Related Islamic jurisprudence and technical aspects, contemporary issues, Moonsighting activities, Islamic calendar in the Organisation of Islamic Countries. Future direction of Islamic astronomy.
Field work and assignments	Calculating and marking the direction of Qiblat; calculating of prayer times at a given reference station using Astronomical almanac; new moon observation at the gazetted National New Moon site.

Generally, the Islamic astronomy subject has attracted many geomatic students including non-muslims.

4.0 Islamic Astronomy Courses For The Public

In coping public needs to learn astronomy especially related to Islamic practices, the Department of Geomatic Engineering has successfully offered several courses since 1994, among them, as follows:

4.1 Islamic Astronomy Certificate Level

It was a part time course offered in 1994 for a duration of one year. Because it was a senate approval course, the entry requirement for the course was either *Sijil Pelajaran*

Malaysia SPM with credit in mathematic or SPM and pass special mathematic test conducted by Academic Committee of the program. The participants of the program comprised engineers, academicians, religious officers, teachers, pilots, company managers and others. The course was run in three modules as summarized in Table 3:

Table 3: Certificate of Islamic Astronomy Course contents
(source: Department of Geomatic Engineering, 1994)

Module	Objective	Course Content
Elementary Module (13 weeks, 4 hour /week)	Understanding elementary astronomy and related geometry	Universe and solar system, celestial sphere, apparent motion of celestial bodies, astronomical coordinate systems, time systems, spherical trigonometry, spherical astronomy and related astronomical calculations.
Intermediate Module (12 weeks, 4 hour/ week)	Understanding basic and intermediate levels of Islamic astronomy	Moon-Earth conjunction, Solar and Lunar calendar systems, Islamic calendar <i>Istilahi</i> system, The determination of Qiblat: Related Islamic jurisprudence and technical aspects, contemporary issues; The determination of Islamic daily prayer times: Related Islamic jurisprudence and technical aspects, contemporary issues.
Advanced Module (13 weeks, 4 hour/ week)	Understanding advanced Islamic astronomy	The establishment of National Islamic calendar: Related Islamic jurisprudence and technical aspects, contemporary issues, Moonsighting activities, Islamic calendar in the Organisation of Islamic Countries. Future direction of Islamic astronomy. Field work: Observation of new moon for calendar determination.

The course participants were awarded **Certificate of Islamic Astronomy** upon successful in all requirements set for the program including a final exam and an oral presentation of a term paper. Based on quite similar content, we have also conducted several short courses to several Islamic religious authorities in Malaysia.

5.0 CONCLUSION

Astronomy subject is still valid for future geomatic engineers because the subject provides the strong foundation to comprehend space based technologies used in geomatic practices. In fact, astronomy should be learned by everyone as through the subject we learn many things about our Universe. Specifically to all Muslims, the astronomy must be enhanced because the subject is closely related to the religious need. Indeed, the developments of space-based Positioning, Navigation and Timing (PNT) technologies such as GPS, Glonass, and other GNSS systems are triggered by astronomical research and development. The clear evidence is that the nations which develop the space-based technologies are the nations that have great infrastructures for astronomy research and education.

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