Development of educational courses on space science technology in Nepal

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Abstract

Space science and Geomatics education in Nepal is recently started on some of the training institution and university of Nepal. Preliminary subjects required for space science and technology have been introduced into science curricula at the higher secondary level of the Nepalese's school, however the benefit of space science and technology have not been appreciated enough. Facilities and resources of teaching science and technology at educational institutions are not yet developed. Attempts have been made to incorporate the elements of space science and technology into undergraduate level of education of the university.

This paper start with the discussion on the space science education in Nepal at the school and college level and mainly focus on initiation taken by the training institution and university of Nepal to introduce the subjects of space science and technology at their curriculum on geomatics engineering and other engineering education. Some recommendation have been made to introduce the different type of educational courses and/or training on space science and technology, which will meet the needs of development to built a general capability in space science as a necessary support for infrastructure development of Nepal and consequently will help to promote the educational activities on space science education in the country.

1. Introduction

Nepal, a sovereign independent Country, is bounded on the north by the Tibetan Autonomous Region of the People's Republic of China, and on the east, south and west by India. The total area of the country is 147181 sq km. The length is 885 Km in east west and breadth varies from 145-241 Km north south. The country can be divided into three broad geographic regions, High Himalayan, Mountainous and Plane region. The country has 5 administrative regions, 14 zones and 75 districts. Population of Nepal as per Census 2001 is 23 million. Land is the only immovable property which can be used as a means for agriculture production as well as a means for financing industrial or commercial enterprises. Space science and technology plays an important role in managing our land, water resources and natural resources. Recently the advancement in space science and technology has given the opportunities for extraction and analysis of required information for the development of day to day activities of all the sectors of the government and private business. Governmental organizations, non governmental organizations (NGO), international non-governmental organization (INGO), private consultants and universities are using space science and technology in the fields of education, agriculture, land management, forestry, bio-diversity, tourism, health medicine and research & development etc.

Space science and technology could address to resolve the major issues such as population growth, environmental degradation, resources management, poverty reduction, urbanization etc. Now a days many sensors are available, which produce the image having resolution from 0.6m up to 90m. The sensor like IKONOS has 1m. Image resolution, Quick Bird has 0.6m image resolution whereas Land Sat has 30 m resolution and thus, for cadastral use Quick Bird / IKONOS image is applicable for high accuracy. Similarly The Global positioning system(GPS) could be used for strengthening Geodetic network, densification of control network, international boundary surveys and helping on various measures for prediction, mitigation and management of disasters by earthquake, avalanche, landslides, floods etc. which occurs very often in Nepal. Thus the space science and technology is very much useful for post earthquake detection, environmental preservation, mapping to create digital maps, to formulate spatial analysis, to detect damage area of disasters etc. However, due to lack of technical expertise, proper higher education in the field of space science and technology, financial support etc. organizations have not been able to realize their full growth and application potential of space science and technology.

2. Education and Awareness in Space science Technology in Nepal:

Space science and technology education is pursued into science curricula in Nepal at the school level. However, schools are not well developed and the challenges are of a higher magnitude. Various governmental and non governmental organizations, institution and universities are involved to organize the education and awareness program in space science and technology in Nepal . Besides these, Nepalese students get higher education in the different universities and institution of the developed/ developing nations of the world in the field of space science and technology. The general problem confronting space science education is the inability of students to see or experiences the phenomenon being taught, which often lead to an inability to learn basic principles and to see the relationship between the concepts and their practical relevance to problems in real life. In addition to this there are also the language problems where science is not taught in their native language and consider as the difficult subject and also there are not enough academically and professionally well trained teachers.

3. Educational courses on Space science technology

Due to increase in population there is a large pressure on the natural resources and widespread concerns about the quality of the environment, ranging from the consequences of climate change, food security, loss of biodiversity, management & mitigation of natural disaster, the occurrence of wide spread and persistent poverty, poor education & health care facilities and poor physical & communication etc, which will meet the needs of development to built a general capability in space science as a necessary support for infrastructure development of Nepal. Against these, back ground development of various educational courses on space sciences and technology is urgently needed in Nepal and thus three course related to space science have been developed on the basis of the education curricula developed by the united nation office of the outer space affairs and the courses are suitable according to the situation of the Asian countries.

The main objective of all the proposed courses is to meet the need of the country to build a general capability in space science as a necessary support for infrastructure development of Nepal. The required minimum qualification for all the courses to study these courses should have the qualification of the Physical science or Engineering Bachelor degree. The duration of the courses is of one year and the teaching method includes the lecture, Tutorials, Practical, Exercise, Seminars etc. After completion of these courses student will get the degree of post graduate diploma.

3.1 Geomatics engineering and Basic Space science

Research and education in astronomy and astrophysics was carried out in many universities and astronomical community has long shown leadership in creating international collaboration and cooperation. Basic space science course is included on the curriculum of the Bachelor of Geomatics Engineering and already implemented. (Curriculum B.E. Geomatics KU/LMTC, 2007)

3.2 Proposed courses on various subjects on space science

Space science and technology is related with the various activities and some of the course structure have been designed and proposed for the implementation. (Adhikary, K.R, ACRS 2008 Sri Lanka, Colombo). Space and atmospheric science, space science & satellite communication, and Satellite meteorology, global climate & remote sensing are the major activities to be address for the development of space science activities in any country.

3.2.1 Course structure of Space and atmospheric science

3.2.1.1 Theory

Module 1: Structure, Composition and Dynamics of planetary atmosphere (Basic concept, dynamics of earth atmosphere, solar radiation and its effect and atmosphere of planet/satellite)

Module 2: Ionosphere Physics (Structure and variability of the earth's ionosphere, ionosphere measurement techniques, plasma dynamics, airglow ionosphere of other planets/ satellites)

Module 3: Solar wind, Magnetosphere and Space weather (Elements of solar physics, magnetic field of earth and planets, magnetosphere space weather, measurement techniques)

Module 4: Astronomy and Astral physics (Introduction, instruments, observation techniques, star galaxies, high energy astronomy, radio astronomy)

Module 5: Spacecraft design, Construction and launch

3.2.2 Practical

Module 1: Ionosphere sounding, Surface monitoring of ozone

Module 2: Optical imaging of plasma depletions, Photometry of binary star

Module 3: Interferometer study of planetary, Mass of suspended particles

Module 4: Optical depth measurement, modeling experiment,

Module 5: Study of solar spectrum

3.2.3 Seminar and Project

Student should have to present one seminar in each of the five theory topics and a pilot project need to be done by the student.

3.2.4 Evaluation

Examination will be carried out regularly to evaluate each student with the allocated marks and grading will be given according to their grade points .The total marks of 1000 are allocated as:

1. Examination (written)	400
2. Class test	100
3. Experiments	200
4. Seminar	100
5. Pilot Project	200

3.3 Course structure of Space science and Satellite communication

3.3.1 Theory

Module 1: Communication system (Telecommunication ,information theory, modulation, code, microwave, optical communication, networking ,protocols, discrete & continuous time signals, z-transformation, discrete Fourier transform and computation, filter, digital signal processing)

Module 2: Satellite communication system (introduction ,Satellite orbit, Satellite configuration, lunching of satellite, space environment ,reliability satellite communication links, frequency band for communication ,Electro magnetic interference EMI, Electro magnetic compatibility EMC, Radio frequency interference RFI)

Module 3: Planning and Earth station technology (network planning, space segment, ground segmentation, control, management of operation, coordination, space law, financial aspect, network op Introduction, earth station sub system, design &fabrication, earth station standards, reliability, operation and maintenance)

Module 4: Transmission and broadcasting (analogue/ digital modulation, forward -error correction coding, spread-spectrum ,multiple access, digital television, TV, internet protocol, satellite news gathering, radio networking, multimedia, video conferencing)

Module 5: Application and operation(satellite communications services, VSAT network, data collection system, search and rescue system, mobile & personnel communication, satellite navigation, multimedia, internet, fixed satellite, mobile satellite, broadcast satellite, multimedia broadcast service, operational communicational satellite systems, international regulation)

3.3.2 Practical

Module 1: Simulation and hardware experiments, demonstration

Module 2: Link parameter calculation, orbit and foot print simulation,

Module 3: Transmit/receive terminal, TV and IP terminal

3.3.3 Seminar and Project

Student should have to present one seminar in each of the five theory topics and a pilot project need to be done by the student.

3.4 Course structure of Satellite meteorology, global climate and remote sensing

3.4.1 Theory

Module 1 Fundamental of meteorology, climatology and remote sensing (Introduction, Basic concept, meteorological satellite orbit, instrumentation and data products, satellite imagery, digital image processing, use of satellite imagery in meteorology and weather forecasting)

Module 2: Parameter retrieval and Application (Radiative transfer, and parameter retrieval, application using digital satellite data, application in oceanography, satellite data assimilation and numerical model, climate studies , environment issues, parameter retrieval, data modeling)

Module 3: Principles of remote sensing (Introduction, history, evolution, electro magnetic radiation, Spectrum, spectral characteristic of crops/ vegetation, soil and water, remote sensing platform, sensor and ground system, image interpretation, photographic interpretation).

Module 4: Digital image processing (overview of programming language, statistical concept, ground data, preprocessing and post processing of digital image processing, radiometric, atmospheric, and geometric correction ,image enhancement, filtering, classification, image fusion ,image segmentation, transformation ,image analysis, projection)

Module 5: Numerical models and global climate (regional and global model, concept of data assimilation, satellite data assimilation, climate change ,greenhouse effect, global warming, anthropogenic effects, impact on climate change, environmental protocol, disaster management)

3.4.2 Practical

Module 1: Operational metrological satellite data handling

Module 2 Parameter retrieval modeling

Module 3 Image processing and interpretation

3.4.3 Seminar and Project

Student should have to present one seminar in each of the five theory topics and a pilot project need to be done by the student.

4. Recommendation

Curriculum of the proposed three different courses of post graduate level on the space & atmospheric science, space science & satellite communication, and satellite meteorology, global climate & remote sensing will meet the need of development to build a general capability in space science as a necessary support for infrastructure development of the developing country. The curriculum could be modified depending upon the availability of the equipment to be used for the module of practical purposes of the concerned institution or university. This proposed curriculum will be very beneficial on the effective use of space science by all the educational institution and university of Asian countries

References

1. *Kathmandu University, Nepal Curriculum B.E. Geomatics KU/LMTC, 2007*
2. *Office of the outer space affairs ST/SPACE/15 Satellite meteorology and global climate education curriculum United Nation 2003*
3. *Office of the outer space affairs ST/SPACE/16 Satellite communication education curriculum United Nation 2003*
4. *Office of the outer space affairs ST/SPACE/17 Space and atmospheric science education curriculum United Nation 2003*
5. *Office of the outer space affairs ST/SPACE/18 Remote sensing and the Geographic information education curriculum United Nation 2003*