

Space and Atmospheric Science

Dr. R. N. Misra
Course Co-ordinator

Dr. R. Sekar
Course Co-ordinator

Physical Research Laboratory (PRL), Dept. of Space
Ahmedabad, India

INTRODUCTION

Developments in the field of Space Science have grown at phenomenal pace. The space explorations in the past 50 years have paved way for new and exciting applications of space. This has been due to relentless efforts of Scientists and Technologists in advancing the frontiers in this branch. The field of space science has matured and it is necessary that the scientist of the developing world join the mainstream of space science to reap benefits of the recent developments. The assimilation of knowledge over the years is expected to spread through



PRL, Ahmedabad - Space Science host institute

education of space science and technology to the international community, particularly to the developing countries. Teaching of Space Science requires dedicated scientists working in the field of space science, and also most importantly, the infrastructure to support the classroom lectures with laboratory experiments and providing facility for hands on experience. Physical Research Laboratory, a premier institute in the field of space science has therefore been chosen as host institution for the PG course in space science.

Four Post Graduate diploma courses in Space and Atmospheric Science have been organized since 1998. These courses are conducted every alternate year at Physical Research Laboratory (PRL), Ahmedabad, The course covers a variety of topics related to Space Science and eminent scientists from PRL, ISRO and other Institutions/Universities in India and abroad are invited to take lectures. Out of the 39 participants who have benefited from this course so far, one participant each have been from Indonesia, Kyrgyzstan, Nepal, Bolivia and Maldives, and 2 each from DPR Korea and Sri Lanka, 5 Participants were from Uzbekistan, 11 from Mongolia and 14 from India.

OBJECTIVES

This is expected that at the end of Space and atmospheric Science educational program, participating scholars would, after return to their countries,.

- Serve as catalysts for furthering the skills and knowledge of other fellow scientists in their countries, Promote the study of space science, thereby increasing awareness among the scientists, by and large, in the region

- Enhance the self reliance in their countries.

TARGET PARTICIPANTS

The course is directed towards the scientists of the Asia Pacific region, working in the allied fields, and who wish to improve their skills in the field of Space and Atmospheric Science, and thereby improve their usefulness to their parent Institutes/Organizations. The prospective participants should possess a Masters Degree in Physics or other equivalent qualification relevant to Space and Atmospheric Science, followed by a minimum of 5 years Teaching/Research/Working experience. Applicants holding Bachelors Degree in Engineering, (B.E/B.Tech.) in Electronics and allied fields, as well as Environmental Science/Engineering, may also be considered, subject to fulfilling criteria of five year experience in the relevant fields. Candidates possessing higher qualifications viz. a PhD, would also be eligible for admission subject to relevant experience of 2 years. They must have sufficient knowledge in written and spoken English.

COURSE STRUCTURE

The Post Graduate Course in Space and Atmospheric Science is organized in two phases-

➤ Phase I (In India)

Phase I of the course consists of five modules:

Modules I, II, III and IV: Lectures and Practicals

The emphasis is on the development and enhancement of the knowledge on the subject. While the Modules I and III constitute Theory Modules II and IV consist of Practicals

Module V (Pilot project):

Oriented towards planning and executing the project to be carried out in the home country as part of Phase-II

➤ Phase II (In home country)

One year Research project to be completed by scholars in their respective countries. It will be a test for techniques learned by the participant during the course

Few meritorious students may be awarded with 1 year fellowship to complete their one year phase-II project work at PRL, Ahmedabad.



Prof. Narayana Rao, Director NMRF Gadanki, Tirupati addressing the participants

On successful completion of the phase-I of the nine months course, the centre will award Post Graduate Diploma. If the participant is able to complete Phase-II project work satisfactorily, Andhra University (India) would award M. Tech Degree in Space and Atmospheric Science to the participants who satisfy the M. Tech eligibility requirements of Andhra University.

COURSE CONTENT

Phase I of the Space and Atmospheric Science course consists of five modules covered over nine months duration.

Module 1: Theory Papers

1. Structure, Composition and Dynamics of Planetary Atmospheres
2. Ionospheric Physics, Atmospheres and Ionospheres of other planets

Module 2: Experiments (Any 5 from the following)

1. Operation of Langmuir Probe
2. Ionospheric Sounding using an Ionosonde
3. Surface Monitoring of Ozone
4. Optical Imaging of Plasma Depletions
5. Characterization of Interference Filters
6. Balloon borne measurements of Atmospheric Ozone
7. Total Electron Content measurements using GPS receiver
8. Measurements of Aerosols by Micro pulse Lidar

Module 3: Theory Papers

3. Solar Wind, Magnetosphere and Space Weather
4. Astronomy and Astrophysics
5. Elements of Space Technology and Instrumentation

Module 4: Experiments (Any 7 from the following)

1. Photometry of Binary Stars
2. Interferometric Study of Planetary Nebulae
3. Mass of aerosols using QCM
4. Optical Depth Measurement Using Filter Photometer
5. Modeling Experiment On Atmosphere/Ionosphere
6. Radio Pulsars Studies using GMRT/OSRT
7. Study of Solar Spectrum
8. Spectral characteristics of Fabry-Perot Etalon for Thermospheric studies
9. Solar Flare Studies using Solar X Ray Instrument (SOXS)
10. Studies of sub millimeter wave (SMM) Receiver
11. Photoionization studies using Recoil Ion Momentum Spectrometer

Module 5: Pilot Project

Pilot project is a short duration project work undertaken by the participant. It is supposed to be precursor to the one-year project undertaken by the participant in their home country. It is selected under consultation from the parent Institution of the participant, so that the pilot project may be extended to one year research work, to be undertaken by the participant, in his/her home country. The participants are encouraged to select a topic, which is of current interest in their home country, and one of the guides is chosen from his/her parent institution, while the other is from PRL.



Course participants at Infra Red Observatory, Mount Abu

Phase II

The one-year project work undertaken by the participant in his/her home country forms the phase II of the course. The report on the one-year project is prepared in the form of a dissertation, which is submitted for evaluation to CSSTEAP. Two referees from the field are requested to review the dissertation. If reports of the referees as well as project guide are satisfactory, a viva voce examination is conducted at participant's place, by a high level committee. Subsequently, the viva voce report, referees comments, and the report of the project guide are forwarded by CSSTEAP, to Andhra University for consideration for award of M.Tech. Degree, in Space and Atmospheric Science. Andhra University would, in turn award the degree of M.Tech. to the participant, if he/she has fulfilled all the other requirements.

COURSE ORGANIZATION

CSSTEAP has arrangements with Physical Research Laboratory (PRL) Ahmedabad, India, a leading institution in the field of Space Science, as host institution for conducting educational and research programs related to Space and Atmospheric Science. The academic program of the course is organized through class room lectures, practicals, self learning books, field excursions, Seminar etc. PRL Library has acquired multiple copies of books in space science as well as English language for the exclusive use of the course participants.

Academic performance of the course participants is evaluated through periodic class tests, seminars, and examinations. English language classes beyond office hours in the evening are also conducted during Module-I of the course for improving English communication and writing skill of the course participants.

The faculty of the course constitutes scientists in different fields, mainly drawn from PRL and also from other centers of ISRO/DOS and Universities/various agencies from India. The core faculty



At Udaipur Solar Observatory, Udaipur

and these experts have long and varied experience in the field of Space and Atmospheric Science. International visiting faculty from Europe and USA etc. are also invited to conduct lectures, tutorials etc. in specialized topics.

As part of the technical tours, The participants visit select institutions in the field of space science after completion of teaching work of Modules I and III . These include various centers of ISRO and other Laboratories. These tours are

also utilized to conduct some of the sophisticated experiments at the respective institutions during the course period. The course participants also get opportunity to experience Indian rich historic, cultural and social heritage during the educational visits to various cities of India. Students are accommodated in fully furnished with good living facilities international hostel located in Bopal campus.

ACHIEVEMENTS IN PAST 10 YEARS

- Since last 10 years CSSTEAP through the host institute PRL Ahmedabad , had conducted 4 post graduate courses in Space and Atmospheric Science. This educational program had benefited total 39 scientists/researchers from 9 countries of AsiaPacific region and one country from outside the region. The course participants had carried out pilot project works on various aspects of Space and Atmospheric Science during module-V of Phasel of the course. A summary of pilot project work carried out by the students from various countries of Asia-Pacific region is presented in Table-I.

Table -1 Space and Atmospheric Science (CSSTEAP) PG course student's pilot project themes

S.No.	Country	No of Trainees	Title(s)
1	India	14	<ol style="list-style-type: none"> 1. Laser Sounding of the Atmosphere 2. Optical Imaging of Plasma Depletions 3. Retrieval of Wind Speed from Satellite Data 4. Ionospheric Tomography 5. Atmospheric Aerosols 6. Ground based Study of Ionospheric Plasma Depletions 7. Spectral Imaging of Main Belt Asteroids of Kuiper Belt Objects 8. Multiwavelength Studies of Mesospheric Airglow Emissions 9. Estimation of Fried's Parameter at USO Lake Site 10. Near Infrared Spectroscopy of Asteroids 11. The Study of JHK Photometry of Comet C/2000 WM-1 Linear

			<ul style="list-style-type: none"> 12. Rocket-borne study of atomic Oxygen related night glow emissions 13. Studies of Plasma Depletions and Scintillations using GPS and VHF Scintillation data 14. Study of Ionospheric Plasma Depletions using PRL's All Sky Optical Imaging System.
2	DPR Korea	2	<ul style="list-style-type: none"> 1. Study of the Radiative Properties of the Atmosphere 2. Studies of Ionization Irregularities in the Middle Latitudes
3	Indonesia	1	Geomagnetic Storms and their effects on the F region of the Ionosphere
4	Kyrgyzstan	1	Study of Ozone using satellite Data
5	Maldives	1	Sun-photometer study on seasonal and diurnal variations in aerosol optical depth spectrum over Male'
6	Mongolia	11	<ul style="list-style-type: none"> 1. Influence of Tropospheric Parameters on Total Ozone Content 2. Study of the Radiative Properties of the Atmosphere 3. The Potential of GIS Techniques in the Study of Climate 4. Study of Convective clouds 5. Simulation of Photolysis Rates in a Box model 6. Long Term Temperature Changes in the Stratosphere over the Mongolian Region 7. Modelling of Tropospheric Ozone 8. Temperature Inversion at Lower Altitudes over Ulaanbaatar, Mongolia and its effect on Aerosol & Trace Gas Dispersal 9. Long Term Temperature Variation over Mongolian Region 10. Long term changes in meteorological parameters over Mongolia 11. Analysis of changes in visibility and rainfall during 1993-2003 over selected locations in Mongolia and examination of possible human impact
7	Nepal	1	Total Ozone Measurement over Kathmandu using Brewer Spectrophotometer
8	Sri Lanka	2	<ul style="list-style-type: none"> 1. Photometric & spectroscopic Observation of VW Cephei Eclipsing Binary star 2. Study of the binary system V367 Cygni
9	Uzbekistan	5	<ul style="list-style-type: none"> 1. Theoretical Aspects of Astrophysical Problems. The first cycle of Solar Proton-Proton reaction with outgoing Neutrino flux 2. Design of Proton Precession Magnetometer 3. Solar Furnace Gamma Ray Telescope 4. Nonlinearity in tropospheric chemistry models 5. Characterization and Observations of Astronomical Grade Array Detectorss
10	Bolivia	1	Ozone Layer over the Bolivian Altiplano : A Model

(Total 39 students from 9 countries of Asia-Pacific Region one country from out side the region)

- 9 students representing 3 countries of Asia-Pacific region completed Phase-II home country research project work and had been awarded M.Tech degree by the Andhra University. Thesis works cover various research problems in Space and Atmospheric Science and a summary is given in Table-II.
- To boost the research activity of the Centre, CSSTEAP supported four meritorious students of 3rd Space and Atmospheric Science course (2002-2003) to carry out Phase-II M. Tech research project work at PRL Ahmedabad, under the supervision of PRL faculty. Fellowship in the form of living and project allowances is provided to the students. The thesis topics are 4,5,6 and 7 as given in table II

Table II Space and Atmospheric Science course Phase-II completed M. Tech. Thesis Titles.

S.No.	Country	No of student completed	Title(s)
1	India	7	1. Ionospheric Tomography at Low Latitudes 2. Study on Atmospheric Aerosols by measuring the Aerosol optical depth using Hand Held Sun Photometer. 3. Multisatellite Observation of Indian Ocean Tropical Cyclones. 4. Characterizing X-Ray Emission from Solar Flares using Solar X- Ray Spectrometer (SOXS) 5. Near-Infra Red Studies of Transient Clouds on Titan. 6. Chemistry of Lower Ionosphere of Mars 7. Estimation of Fried's Parameter at USO Lake Site
2	Nepal	1	Total Ozone Measurements over Kathmandu using Brewer Spectrophotometer
3.	Sri Lanka	1	Photometric and Spectroscopic Observation of VW Cephei Eclipsing Binary Star" (August 2000).

In addition to long terms PG course on Space Science last 10 years CSSTEAP organized & supported an X-ray Workshop on "Data processing from the Chandra & XMM-Newton space missions" held at Udaipur during January 13-24, 2003. These courses/workshop had benefited 26 scientific/technical personnel from 4 countries of Asia Pacific region and also benefited 2 participants from 2 countries outside Asia-Pacific region.

- During this 10 years period, the centre had published 10 number of lecture volumes covering syllabus of PG course in Space and atmospheric science.