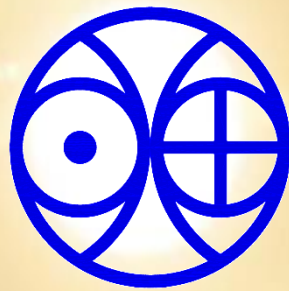


# **Announcement of 10<sup>th</sup> Post Graduate Course**

## **Space and Atmospheric Science**

**August 1, 2016- April 30, 2017**

*To be held at*



***Physical Research Laboratory***  
***Ahmedabad-380 009, India***



***Organized by***  
**Centre for Space Science and Technology  
Education in Asia and Pacific (CSSTEAP)**  
**(Affiliated to the United Nations)**

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## INTRODUCTION

Space technology plays a very important role in improving the quality of life of today's human society for information and decision making. Most noticeable are



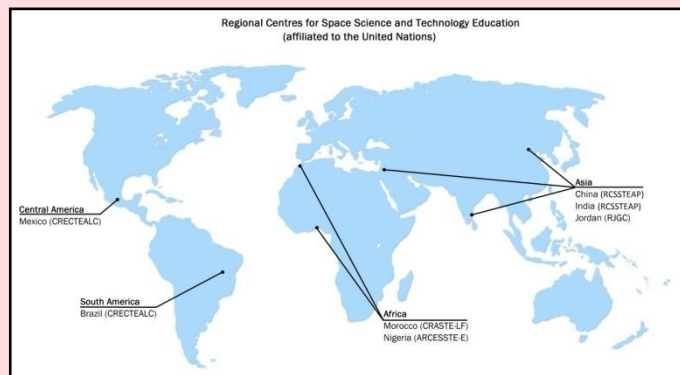
**Office for Outer Space Affairs (UN-OOSA)**

communication, television, telemedicine, satellite navigation, remote sensing data, weather forecasting, disaster mitigation through emergency mapping, etc. All countries, irrespective of rich or poor, have realised the importance of space technology for improving the living conditions of their citizens. Therefore, all countries should have access to space technology and must share the equitable benefits. The global satellite data availability has made it possible for all countries to get

benefits. However, a major precondition to successful space technology applications is the development of essential indigenous capabilities, particularly human resources. A consensus emerged within the international community that if effective assimilation and appropriate application of space technology are to succeed in the developing countries, efforts must be made at different levels for capacity building in space technology. Towards this, the United Nations General Assembly called for the establishment of Centres for Space Science and Technology Education at the regional level in the developing countries. Under the auspices of the United Nations, through its Office for Outer Space Affairs (UN-OOSA), the four regional Centres established are: Asia and the Pacific (India), Latin America and the Caribbean (Brazil and Mexico) and Africa (Morocco, Nigeria). All of these Centres are affiliated to the United Nations through UN-OOSA. A fifth Centre in Western Asia (Jordan) will be established in the future.

### The Regional Centre for Asia and the Pacific in India

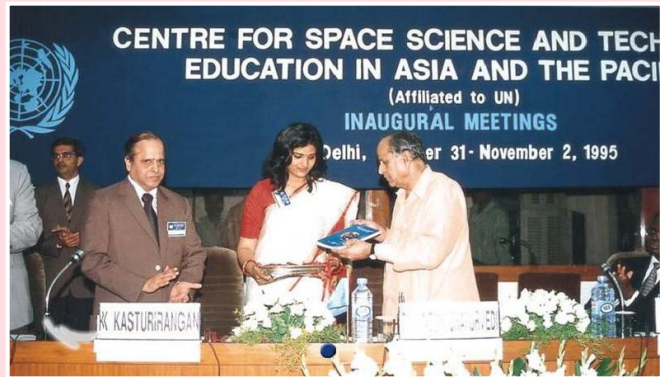
The Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP) was established in India in November 1995 with its headquarters in Dehradun and is the Centre of Excellence. The 1st campus of the centre was established in Dehradun, India at Indian Institute of Remote Sensing (IIRS) which is a unit of Indian Space Research



**Regional Centres**

Organization (ISRO), Government of India. For conducting its Remote Sensing & GIS programs the Centre has arrangements with IIRS as a host institution. The Centre has also arrangements with Space Applications Centre (SAC) Ahmedabad, playing as host-institution for programs related to Satellite Communications, Satellite Meteorology and Physical Research Laboratory (PRL) Ahmedabad for Space and Atmospheric Science.

The Centre has been imparting education and training, helping participants in developing research skills through its Master Degree and Post Graduate courses. This is achieved through rigorous class-room (theory and hands on exercises), group discussions, field campaigns and pilot projects in the field of space science and technology. These programs aim at capacity building for participating countries, in designing and implementing space-based research and application programs. The Centre also fosters continuing education to its alumni for advance research leading to Ph.D. degree.



(CSSTEAP) was established in India

**“It should be emphasized that the overall mission of the centre is to assist participating countries in developing and enhancing the knowledge and skills of their citizens in relevant aspects of space science and technology in order that such individuals can effectively contribute to national development programmes.”**

#### **AFFILIATION TO THE UNITED NATIONS**

**The Centre has entered into a cooperative agreement with the United Nations which states that the United Nations will cooperate with the Centre by providing expert advice, educational curricula, technical support, necessary documentation and other appropriate support.**

#### **EDUCATIONAL PROGRAMME AND COURSES**

The educational program of the Centre is oriented towards the dissemination of knowledge in relevant aspects of space science and technology. The emphasis of the



Office for Outer Space Affairs (UN-OOSA)

Centre at Granada, Spain in February/March 1995. These curricula are reviewed periodically by an International Advisory Committee. The activities of the Centre are guided by a Governing Board consisting of 16 member countries.

Centre is to deliberate on education and research in the field of space science with emphasis on theoretical studies and hands on experience on state of art instrumentation, continuing education and awareness and appraisal programs. The curriculum has been developed under the auspices of the UN Office for Outer Space Affairs (UN-OOSA) and the guidelines emerged from the meetings held for Education Curriculum Development for the

## ACADEMIC ACTIVITIES

The academic activity is divided into two phases. Phase-I is of 9 months duration and executed at the Centre in India. After successful completion of the Phase-I, the participants are encouraged to take up Phase-II research project of one year duration in their home country. Phase-II allows participants to take up research project relevant to their home country or organization and apply the technologies.

If desired by the candidate then candidate can submit one year research project to Andhra University, Visakhapatnam, India for Master's Degree (M. Tech. Degree). The eligibility criteria of the university will apply.

(i) **Post Graduate Programme:** P.G. Courses of nine months duration are organized in the following disciplines:

- Remote Sensing and Geographic Information System (RS and GIS) (at IIRS, Dehradun)
- Satellite Communications (SATCOM) (at SAC, Ahmedabad)
- Global Navigation Satellite System (GNSS) (at SAC, Ahmedabad)
- Satellite Meteorology and Global Climate (SATMET) (at SAC, Ahmedabad)
- Space and Atmospheric Science (SAS) (at PRL, Ahmedabad)

Core Modules (Semester I and II) emphasize on the development and enrichment of the basic knowledge and skills of the participants in the field of space science and technology. This is followed by pilot project, which provides an opportunity to fine-tune the skills for carrying out research in space science.

(ii) **Master's Programme:** This programme gives an opportunity and continuity in developing higher research skills for those who have completed successfully the nine months P.G. Course. This is subject to qualifying for admission requirements of Andhra University, India. A research project by the scholars is conducted and executed in their respective countries with a view to transfer the technology in his/her organization. It will also be a test of the methodology and knowledge assimilated during phase-I at the centre.

### RECOGNITION OF MASTER'S PROGRAMME

**The Centre is in agreement with Andhra University (est. 1926) Vishakhapatnam, India for award of M. Tech. Degree. The terms and conditions of this agreement are reviewed from time to time. A few meritorious students of P.G. Course are also considered for award of additional fellowship of six months to one year to complete part of their research work at Centre's host institutions in India which may lead to a M. Tech. Degree of Andhra University.**

(iii) **Short Courses:** Besides P.G. level courses, the centre also conducts short term courses of two to four weeks duration in specific themes of above subjects regularly.

The Centre has so far conducted 46 post graduate courses (19 on RS&GIS, 9 each on SATCOM, SATMET and SAS). The centre has also conducted 41 short Courses

/Workshops. These educational programs have benefited 1504 participants from 49 countries in the region and 29 participants from 18 countries outside Asia Pacific region. Eighteenth RS & GIS course at IIRS Dehradun and ninth SATCOM course at SAC Ahmadabad are in progress. Centre also organized two special courses with UN-OOSA/UN-SPIDER/UN-ESCAP, IWMI on themes Flood Risk Mapping, Modeling and Assessment using Space Technology and Development of Geo-referenced Information System for Disaster Risk Management

### **Alumni Meet**

Alumni meets were organized to develop a network and to establish meaningful linkages between CSSTEAP, faculty and its past students. These were aimed to provide common platform to interact and apprise about the latest development in the space technology and its applications. Such meets were held in Nepal, Bangladesh & Sri Lanka in 2011. These meets took place in Kathmandu, Dhaka and Colombo. The centre proposes to 2-3 such meetings in coming years in different countries.

**NEXT COURSE** : **10<sup>th</sup> P. G. Course in Space and Atmospheric Science**  
**Duration** : **August 1, 2016 to April 30, 2017**  
**Venue** : **Physical Research Laboratory,  
Navrangpura, Ahmedabad 380 009, INDIA**  
**Number of seats** : **15**

### **IMPORTANT DATES**

**Last date for Receipt of Applications** : **March 1, 2016**  
**Information of Selection** : **April 30, 2016**  
**Commencement of Course** : **August 1, 2016**  
**Completion of Phase-I (in India)** : **April 30, 2017**  
**Admissions in M. Tech** : **May, 2017**

The list of selected candidates will be available on our website [www.cssteap.org](http://www.cssteap.org) by last week of April, 2016. Selected candidates may initiate the action to join the course. Since the numbers of seats are limited, applicants are advised to process their applications well in advance of the last date to avoid inconvenience.

### **WHO CAN APPLY?**

The course is designed towards the scientists, teachers, professionals and specialists of the Asia Pacific region, working in the field of space science and allied fields, who wish to improve their skills in the field of Space and Atmospheric Science, and thereby improve their usefulness to their parent Institutes/Organizations.

It is strongly expected that the participating scholars will be able to:

- Serve as catalysts for furthering the skills and knowledge of other professionals in their countries.
- Enhance the self reliance of their respective countries so as to lessen dependence on external experts.



## **HOW TO APPLY?**

Applications are invited from candidates in countries of Asia and the Pacific Region for the 10th P. G. Course in Space and Atmospheric Sciences. All the candidates need to be sponsored (i.e. endorsed) by recognized institutions (e.g. ministries or universities in their respective countries). Sponsoring institutions/authority should ensure that on return, the scholar will be given opportunity to work in a development oriented activity in the area of newly acquired knowledge and skills. The execution of a one year project work in their respective countries is the beginning of this process and it is assumed that sponsoring authority will facilitate one year research project in the home country. However, the Centre will provide long distance technical guidance. A limited number of short and long term fellowships may be made available to meritorious participants to complete Phase II Research Project work in India.

Please submit the duly filled application form through the CSSTEAP Governing Board member of your country to the Indian Embassy/High Commission in your country (For list of the members please see inside of the front cover page). However, the applicants from non-Governing Board Member countries need to submit completed application forms to the Centre through the Embassy/High Commission of the respective country in New Delhi, India. The application should be completed in all respects and accompanied by attested and/or certified copies of all the certificates (School, Bachelor and Master, TOEFL, English Proficiency, etc.). Wherever, these certificates are issued in a language other than English, the same may be translated in English and certified by the Head of the organization or provide English transcription of all such documents. However, an advance copy may be forwarded at the following address for advance action and follow-up at this end:

### **The Course Director**

#### **Space and Atmospheric Science**

Physical Research Laboratory,

Navrangpura, Ahmedabad 380 009, INDIA

Telephone # +91-79-26302275 and +91-79-26314507

Fax # +91-79-26302275 and +91-79-26314507

Email [uncsc@prl.res.in](mailto:uncsc@prl.res.in)

**Note: Those who are applying for TCS fellowship shall also include a copy of the duly completed form submitted to the Embassy/High Commission of India in their country.**

To download application form or to know more about CSSTEAP, its past and future programmes, participants and countries who have benefited from these and the Pilot Projects carried out through these programmes, please visit us at [www.cssteap.org](http://www.cssteap.org)

## **ELIGIBILITY FOR ADMISSION**

The prospective participants should possess a Masters Degree in Physics or other equivalent qualification relevant to Space and Atmospheric Science, OR Bachelor's Degree in Engineering, (B.E./ B. Tech.) in Electronics and allied fields / Environmental



Science/Engineering. Candidates having teaching or research experience would be preferred. Candidates possessing higher qualifications viz. a Ph. D., would also be eligible for admission.

**Important: The applicants are advised to bring original documents for verification at the time of reporting in India.**

### **SELECTION PROCEDURE**

The Centre will select the candidates through a well laid procedure, which includes satisfying academic eligibility, proficiency in English language, funding/forwarding by sponsoring authority/organization, country representation, etc. Only selected candidates will be intimated by 30th April 2016 and list of selected candidates will also appear at Centre's web-site ([www.cssteap.org](http://www.cssteap.org)). Preference in selection will be given to those candidates whose expenses are borne by the candidate/sponsoring agency. Once a candidate has been sponsored and admitted, the sponsoring authority/organization or candidate need to inform at least 15 days in advance for withdrawal or cancellation of the candidature. If the sponsoring authority wishes to call back its candidate after joining the Centre or in the middle of the course, the travel cost need to borne by either sponsoring authority or by the candidate itself.

### **ABOUT HOST INSTITUTE (Physical Research Laboratory)**

Physical Research Laboratory (PRL), founded in 1947 by Dr. Vikram Sarabhai, is a premier scientific institution under the Department of Space Government of India. As is very well depicted in its logo, PRL research encompasses the earth, the sun immersed in the fields and radiations reaching from and to infinity, all that man's curiosity and



intellect can reveal. The research activities are multi-dimensional and cover Astronomy and Astrophysics, Solar Physics, Planetary Sciences and Exploration, Geosciences, Space and Atmospheric Sciences and Theoretical Physics. PRL has four campuses –the main campus is at Navarangpura, Ahmedabad and the others are at Thaltej, Ahmedabad, the infra – red observatory at Gurushikhar, Mount Abu, and the Udaipur Solar Observatory at Udaipur. PRL is contributing significantly to the scientific manpower development through Doctoral (Ph.D.) and Post-Doctoral programmes, Associateship Programme for

university teachers, Summer Programme for M.Sc. students and college teachers and Project Training of Engineering, MCA and Diploma students. PRL alumni have played a key role in building and contributing to the development of other institutions in the country. The Indian Space Research Organization (ISRO) was nucleated in PRL in the early seventies. Two of the past Chairmen of ISRO - Professor U.R. Rao and Dr.K. Kasturirangan - are alumni of PRL. For further details you may visit PRL website: <http://www.prl.res.in>

### FACULTY

The faculty for the course constitutes experts in different fields drawn from the Physical Research Laboratory, Ahmedabad, a number of ISRO Centres and various research institutes and universities in India and abroad. The core faculty has a strong scientific background with a number of publications, experience of participating in international scientific programs, organizing a number of courses / workshops / symposia, etc. to their credit. A few visiting international experts will also be invited to deliver special lectures



### MEDIUM OF INSTRUCTIONS

The medium of the instructions/teaching is English. Proficiency in written and spoken English is most essential. The candidates who are not proficient in English are advised not to apply. Applicants, who have done their higher studies in a medium (language) other than English, are required to submit TOEFL score or a diploma/certificate of English language issued by an accredited language institution or by the local UNDP for



satisfactory establishment of the applicant's competence in spoken and written English language. Preference will be given to those who secure high score in TOEFL examination.

## TEACHING METHODS AND FACILITIES

Modern facilities exist at the Centre for class-room teaching and practical instructions/demonstrations. Printed as well as digital course material of the lectures is supplied. The teaching methods include class room lectures, video lectures, computer based training packages, laboratory experiments, group discussions, demonstrations, and seminar presentations.

Physical Research Laboratory, Ahmedabad is a premier institution of space research in India. A number of sophisticated experiments like digital ionosonde, high power LIDAR, optical instruments for photometry, spectrophotometry and imaging of day/night airglow emissions, instruments for surface/in-situ measurements of ozone, aerosols, trace gases, conductivity, electric fields in the middle atmosphere and of electron density, ion-neutral composition and electric fields in the ionosphere, form the backbone of the current space research activities.



PRL has also acquired highly sophisticated experimental facilities such as the Ion Probe, Stable Isotope Mass Spectrometer, Gas Chromatographs and a state of the art Thermal Ionization Mass Spectrometer (TIMS) for studies in Planetary and Geosciences. A nano-SIMS and a Noble Gas Mass Spectrometer have been commissioned. These instruments are capable of measuring isotopic ratios of different elements very precisely, and will help to study solar system, planetary and geological evolutionary processes and their time scales. A state-of-the-art Isotope Ratio Mass Spectrometer has been set up under IWIN project, which can measure the isotopic ratios of heavier and lighter isotopes.





For astronomy and Solar Observations, two dedicated Observatories, one operating in Infra-red and other in visual bands are there at Mount Abu and Udaipur, respectively. An ambitious research plan for the next five years has been drawn up and Space based experiments in Astronomy, Atmospheric and Planetary sciences are proposed. Computer facilities include a number of high power workstations with a large number of PCs connected through network with connectivity to Internet. PRL hosts an excellent library with a large collection of books and periodicals in varied fields of Space and Atmospheric Sciences.

### **EDUCATIONAL VISITS**

As a part of the course curriculum, the participants will have the opportunity to visit different centers of ISRO / Dept. of Space, Govt. of India and other organizations concerned with space research.

### **PERFORMANCE EVALUATION**

The performance of the participants is assessed through written, interactive-sessions and/or computer-assisted practical exercises. Independent assessments of theory exams are conducted by external and internal faculty. However, the practical examination is conducted jointly. The participants need to pass each examination paper. Participants, who fail to qualify in the examinations in the nine months course, may be considered for award of only a "Certificate of Attendance" by the Centre.

### **AWARD OF DIPLOMA/DEGREE**

On successful completion of the Phase-I study, i.e. nine-months course, the participants will be awarded Post Graduate Diploma. Certificate of Attendance will be given to the candidates who fail to qualify. If the participant is able to complete Phase-II Project work, i.e. research project in home country satisfactorily within four years thereafter the work can be submitted to the Andhra University (India) for award of M. Tech. Degree.

### **COURSE EXPENSES**

The overall expenses of the course are given below, this is besides the international travel (to and from city of the course participant to course venue):

- Course Fee : US \$ 6000 per participant
- Local tours : US \$ 1200 per participant
- Living expenses : US \$ 1100 per participant

The participants outside the Asia-Pacific region are expected to find suitable sponsorships or funding for meeting the expenses while attending the course in India.

#### FINANCIAL ASSISTANCE FROM GOVERNMENT OF INDIA

For this course, Government of India (GOI) has offered to bear the course fee of US \$ 6000 per participant **from the Asia-Pacific region to the selected candidates** by the Centre. Thus no course fee is payable by the selected participants from the Asia-Pacific region. **GOI will provide financial assistance as mentioned** below:

Living expenses in India: INR 16,000 per month for the duration of 9 months.

Book allowance: INR 2,000 per annum

Project allowance: INR 1,500 per annum

Study tours INR 50,000

The Centre is trying to obtain financial assistance for international travel for a limited number of participants of the Asia-Pacific region through agencies like UN Office for Outer Space Affairs (UN-OOSA), UN Economic and Social Commission for Asia and the Pacific (UN-ESCAP). UN-ESCAP has been supporting over the years to the CSSTEAP education programmes and has extended travel grants to a good number of CSSTEAP course participants since its inception. This contribution by UN-ESCAP is highly supportive to the overall CSSTEAP activities.

#### FINANCIAL ASSISTANCE THROUGH TCS

This course is approved by the Ministry of External Affairs, Government of India under its TCS of Colombo Plan Fellowship for the foreign nationals from Afghanistan, Bangladesh, Bhutan, Fiji, Indonesia, Iran, Republic of Korea, LAO PDR, Malaysia, Maldives, Mongolia, Myanmar, Nepal, Papua New Guinea, Philippines, Sri Lanka, Thailand and Vietnam. The fellowship covers to and fro international travel and other training related expenses. The applicants from the above countries are encouraged to apply for TCS Fellowship. The details of this fellowship and prescribed application form may be obtained from the Embassy/High Commission of India in the home country of the candidates and duly completed form need to be submitted to them. Simultaneously, they are required to send their bio-data on the CSSTEAP prescribed application form, appended in the announcement brochure, to Director CSSTEAP, along with a copy of duly completed TCS fellowship form submitted to Embassy/High Commission of India in their country.

Candidates proposing to avail the GOI Fellowship and the international travel assistance have to specifically request for the same in Application Form. Candidates who are not offered GOI Fellowship and travel assistance, have to make their own arrangements for living expenses and international travel.

## INSURANCE

Medical, life and disability insurance should be undertaken before leaving their country for India by all the participants themselves or on their behalf by their sponsoring institute/organization for covering entire health and disability risks. No medical expenses will be borne by the Centre. However, participants who receive the Fellowship of the GOI will be paid medical expenses for minor ailments on actual basis (as out patients only) as and when such expenses are incurred. The Centre will have limited liabilities as far as medical expenses are concerned in such cases. Candidates in sound physical and mental health only need to apply.

**In case if any information requiring medical attention is hidden and if found during the course, the centre will be obliged to send the candidate back home any time. The travel cost will be borne either the sponsoring authority or by the candidate itself.**

## LIFE AT CENTRE

Accommodation will be arranged in international hostel with good living facilities for Participants only. This gives an opportunity for participants to interact and share their knowledge and cultural values.

Accommodation on single occupancy basis is provided to all the selected participants. The campus is equipped with good living facilities, like independent kitchenette, gymnasium, tennis court, etc. A sum of INR 1500/- per month is to be paid by the participant towards the



accommodation. Boarding and other expenses are to be borne by the participants themselves. Since India is country of festivals, the participants get to know about different colourful festivals throughout the year.

## ABOUT THE CITY

Ahmedabad is named after Sultan Ahmed Shah who founded this city in 1411 AD and graced it with splendid monuments. It is a great textile and commercial centre and was called the 'Manchester of India' in the past. Ahmedabad is today a prosperous, thriving city, the second largest in western India. The pre-Mughal Muslim Hindu styles. The 9-day dance festival of Garba (October-November), followed 20 days later by the light and cracker festival of Divali, the kite festival of Makarasankranti (January 14) and the color festival of Holi (March) are occasions to enjoy.

Ahmedabad is associated with Mahatma Gandhi, the apostle of peace and nonviolence whose Ashram or retreat, on the banks of the river Sabarmati is now a place of national pilgrimage. It is also the home of many premier academic and cultural institutions, mainly due to the vision of Vikram A. Sarabhai, who was the founder of PRL. Prominent among them are Ahmedabad Textile Industries Research Association, National Institute of Design, Indian Institute of Management, Institute of Indology, Vikram Sarabhai



Community Science Centre and Darpana Academy of Performing Arts apart from PRL and Space Applications Centre (SAC). The city is well connected by rail, road and air with all major cities in India. There are daily air services from Delhi, Mumbai, Chennai, Kolkata and Bengaluru . PRL is situated about 8 km from railway station and about 15 km from the airport.



## **WEATHER**

The weather of Ahmedabad is predominantly warm throughout the year except for brief cold spell during second half of December and the month of January, when minimum temperatures may go to 4-6° Celsius for a few days. Light woolens are advised during this period.

### **Rainfall**

Annual Average	780 mm (mostly during 15 June - 15 September)
Highest	1997 mm in the year 1927
Lowest	214 mm in the year 1918

### **Temperature**

Highest:	47.8°C on 27 <sup>th</sup> May, 1916
Lowest:	2.2°C on 6 <sup>th</sup> February, 1920

## Space and Atmospheric Science Course

The M. tech programme as per guidelines of Andhra University Visakhapatnam consists of two phases as below:

### **The phase I (Nine months)**

This part of the course of PG Space and Atmospheric Science Course, which is of nine month duration, is organized in two semesters of 20 & 19 weeks each. There are Four theory papers and six laboratory experiments in the first semester, while Two theory papers, pilot project and six more laboratory experiments are to be completed in the second semester. Introductory lectures on topics covering all the branches of space science and technology are taken in the beginning of the course for about one or two weeks. These topics together form common module.

### **Details about the topics of COMMON MODULE**

- 1) Properties of Electromagnetic Spectrum :reflection, refraction, absorption, emission, scattering, polarization – effect of atmosphere on the propagation of EM radiation and its impact on various applications – fundamentals of radiometry – definition of radiometric quantities.
- 2) Orbits and Platforms :Types of orbits – viewing geometry – types of satellites, main frame subsystems, payloads, GPS
- 3) The Universe : its structure, constituents and origin
- 4) Ionosphere : its structure and role in communication
- 5) Solar Activity : it influences on terrestrial phenomena and space weather
- 6) Earth's Atmosphere: its structure, composition and long term variability, basic meteorological parameters. Land-ocean-atmosphere interaction affecting weather
- 7) Meteorological Satellite Applications: Parameter retrieval, application of Met Satellite – cyclone tracking, weather forecast, agro meteorological service etc.
- 8) Global Climate and Climate Change: Radiation balance, influence of CHG, sources and monitoring of CHG – International Coordination – IPCC.
- 9) Evolution of Communication Satellites: Early days, Passive satellites, Active satellites, Operational systems, Evolution of INTELSAT satellites, Evolution of Earth stations, Evolution of Regional and Domestic satellite systems, Evolution of satellite services, Important satellite operators at present in FSS / MSS / BSS / DAB / B-MBS / Satellite Navigational systems, pros & cons of NGSO / GSO Orbits for communications satellites
- 10) Elements of Satellite Communications Systems: Space segment, Ground segment, network configurations for different services, radio spectrum, Allocations of frequency bands
- 11) Satellite Communications Link and Propagation Effects: Link quality, Link parameters, Satellite communications systems model, Link Budget, Performance of time specifications, Radio wave propagation mechanisms, Radio wave propagation factors, propagation through atmospheric gases, Radio noise in satellite communications
- 12) International Regulations: Radio regulations, Frequency allocations, Frequency assignment steps, Regulations relating to satellite networks, Procedure for applying to non-planned bands, Satellite – terrestrial coordination, GMPCS- MOU, Role of ITU, WTO agreements, Harmonization of Regulations in Europe

**13)** Applications and Trends in Satellite Communications: Applications trends, Connectivity trends, Technology trends, Frequency trends, Regulatory trends, User trends, Global market trends

**14)** Basic Principles of Remote Sensing: end to end system concept – concept of signature - remote sensing sensors – overview – optical and thermal, microwave – sensor parameters – past, present and future sensor system.

**15)** Data Reception and Data Products: organization of ground system for data reception, preprocessing – radiometric and geometric correction – special processing – georeferencing, output medium - data analysis – visual image analysis – digital classification, classification accuracy atmospheric effect.

**16)** Geographic Information System (GIS)

**17)** Applications of Remote Sensing: food security, water resources management, environmental monitoring and conservation, inputs for infrastructure development etc.

**18)** Space Law

## **Course Contents**

### **Paper titles and contact hours of SAS**

<b>Semester 1</b>		
<b>P. S. N.</b>	<b>Name</b>	<b>Hours</b>
<b>SAS.101</b>	Atmosphere	40
<b>SAS.102</b>	Ionosphere	40
<b>SAS.103</b>	Ground Based Techniques	40
<b>SAS.104</b>	Space Instrumentation	40
<b>SAS.105</b>	Space Exploration	40
<b>SAS.106</b>	Practical	100
<b>SAS.107</b>	Seminar	25
<b>Semester 2</b>		
<b>P. S. N.</b>	<b>Name</b>	<b>Hours</b>
<b>SAS.201</b>	Magnetosphere	40
<b>SAS.202</b>	Solar and Radio Astronomy	40
<b>SAS.203</b>	Stellar Astronomy	40
<b>SAS.204</b>	Elective Paper 1	40
<b>SAS.205</b>	Elective Paper 2	40
<b>SAS.206</b>	Practical	100
<b>SAS.207</b>	Seminar	25



## Details of the individual theory papers

### Semester 1: 5 papers 200 Marks each

#### **SAS.101    Atmosphere (40)**

##### **1.1 Concepts of Earth's Atmosphere (10)**

Basic Structure of Atmosphere - Hydrostatic Equilibrium - Scale Height - Geopotential Height Thermodynamic Considerations - Elementary Chemical Kinetics - Composition and Chemistry of Lower, Middle and Upper Atmosphere - Thermal Balance in Thermosphere .

##### **1.2 Effects of Solar Radiation on Atmosphere (5)**

Solar Radiation at the Top of the Atmosphere - Attenuation of Solar Radiation in the Atmosphere - Radiative Transfer - Thermal Effects of Radiation - Photochemical Effects of Radiation

##### **1.3 Aerosols, Greenhouse Gases and their effects on Radiation Budget (15)**

Aerosols & Radiation Budget - Long Term Climate Impact - Black Carbon & Dust-Greenhouse Gases - Carbon monoxide - Carbon dioxide - Oxides of Nitrogen - Methane - Atmospheric Ozone - Ozone Chemistry - Ozone Hole .

##### **1.4 Dynamics of Earth's Atmosphere (10)**

Equation of Motion of Neutral Atmosphere - Thermal Wind Equation - Elements of Planetary Waves - Internal Gravity Waves and Atmospheric Tides - Fundamental Description of Atmospheric Dynamics and Effects of Dynamics on Chemical Species

#### **SAS.102    Ionosphere (40)**

##### **2.1 Structure and Variability of Earth's Ionosphere (13)**

Introduction - Chapman's Theory of photo-ionization - Continuity equation and photo-chemical equilibrium - Loss processes -  $\alpha$  and  $\beta$  Chapman layers - Chemistry of E and F1 regions - D region chemistry - Water cluster ions and their significance - Electron attachment and negative ions in the D region - F region processes - F layer splitting - Vertical transport - Ambipolar diffusion and F2 peak - Topside ionosphere - Diffusion between ionosphere and protonosphere - Morphology - diurnal, seasonal and solar cycle variations of ionospheric regions - F- region anomalies - SIDs

##### **2.2 Ionospheric Plasma Dynamics (13)**

Properties of magneto plasma - Gyro frequency - Plasma frequency - Debye length and Frozen in field - Basic fluid equation - Steady state plasma motions due to applied forces - Electrical conductivity of the ionosphere - Generation of electric field and electric field mapping - Ionospheric dynamo - Ionospheric irregularities - Equatorial Spread F and Equatorial Electrojet (linear theories) - Mid-latitude ionospheric irregularities - Sporadic E

##### **2.3 Electromagnetic Wave Propagation in Ionosphere (14)**

Theory of Wave propagation - Properties of plane waves in isotropic and anisotropic media - Group propagation - Ray and group velocities - Radio waves in ionized media - Propagation in isotropic plasma and refractive index - Concepts of critical frequency and virtual height - Magnetoionic theory - Appleton-Hartree formula for refractive index - Ordinary and extraordinary waves - Reflection conditions - Deviative and nondeviative absorption formulas - Oblique incidence propagation - MUF and skip distance.

## **SAS.103    *Ground Based Techniques (40)***

### **3.1 Radio Antenna (12)**

EM radiation - Small dipoles and Loops - Half wave dipole - Antenna Arrays - Reflector Antenna - Applications for Radio Astronomy - Transmission lines and Impedance Matching Techniques - Receivers and Transmitters

### **3.2 Radio sounding (12)**

Ionospheric Absorption Techniques - Ionosonde - HF and VHF Radars - Coherent and Incoherent Scatter Radars (HF, VHF and MST) - Radio Beacon Techniques - Global Positioning System (GPS),

### **3.3 Optical Techniques (10)**

Photomultiplier Tubes - Image Intensifiers - Lasers - Semiconductor Photonic Devices - Photo diodes - Avalanche diodes - Laser diodes & CMOS imaging detectors -- Imagers - Interference Filters and Etalons - Fabry Perot Interferometer - Filter Photometers - Lidar, - Aerosols, Trace Gases and Ozone measuring devices.

### **3.4 Airglow (6)**

Airglow - Oxygen green and red line emission - Nightglow - Dayglow - Twilight Glow -- Applications of Airglow Measurements for Ionospheric Dynamics

## **SAS.104    *Space Instrumentation (40)***

### **4.1 Launch Vehicles, Satellites and their Orbits (5)**

Principles of Rocketry - Rocket Motors - Solid and Liquid Fuel Rockets - Sounding Rockets - Cryogenic engines - Multistage Rockets - Satellite Launch Vehicles - Basics of Satellite orbits- Kepler's Laws - Sub-satellite Point - Orbital Parameters - Sun-synchronous and geosynchronous Orbits - Low-Earth Orbits

### **4.2 Attitude Control, Power and Thermal systems of Spacecrafts (10)**

Attitude Sensors - Sun Sensors - Star Sensors - Earth Sensors - Magnetic Aspect Sensors- Accuracy - Spin Stabilization and Gyros - Control of Flight-path - Close-loop Guidance, Spacecraft Power System - Solar Cells and Panels - Primary and Secondary Batteries— Special Power Sources - Radioactive Thermoelectric Generators (RTG) , Spacecraft thermal control techniques

### **4.3 Selection of Materials for Space -borne payloads (5)**

Behavior of Materials in Space (Temperature, Pressure and Radiation) - Outgassing - Corona Discharge— Coating and Coating-compounds - Radiation Damage - Mounting of Subsystems - Structural and Mass Limitations - Carbon Fiber Reinforced Plastic (CFRP) - Honeycomb Structures —Effects of Vibrations and Shocks on Spacecraft Structures - Spacecraft Thermal Environments - Thermal Paints and Surface Finish

### **4.4 Reliability, Tests and Qualification of Payloads for Space Experiments (5)**

Fabrication of Electronics - Subassemblies- Electromagnetic Compatibility—Checkout, Reliability Considerations and derating - Test and Evaluation - Thermovac tests - Vibration and shock tests

### **4.5 Telemetry, Tracking, Command (TTC) and Data Handling System (5)**

Telemetry System - Signal Conditioner, Onboard Data Recorder, Telecommand - Encoder—Decoder—Pulse and Data Commands - RF Systems - Receivers, Transmitters and Antenna— Ground Segments - Real-time and Off-line — Tracking

#### **4.6 In Situ Techniques on Space Platforms (10)**

Langmuir Probe – Electric Field Probe – Ion Drift Meter – Retarding Potential Analyzers – Mass Spectrometers and Magnetometers – Satellite based temperature measurement – Satellite Drag for Neutral Densities

### ***SAS.105 Space Exploration (40)***

#### **5.1 Atmospheres of other Planets and Satellites (10)**

Inner and outer planets - Structure and Composition of atmospheres planets (e.g. Jupiter, Mars, Venus and Saturn) - their important Satellites

#### **5.2 Ionospheres of Planets and their Satellites (10)**

Ionospheres and magnetospheres of solar planets (Mars, Venus, Jupiter, Saturn etc.) and those of natural satellites (e.g. Titan), Extra-solar planets and their search procedures

#### **5.3 Data Analysis Techniques (10)**

Data resources, Data processing, Error analysis - Time series – Fourier Transform – DFT – FFT –Least Square Method – Linear Fitting – Statistical test of Significance – Correlation – Chi Square Test.

#### **5.4 Examples of science and application satellites (10)**

Indian and foreign operating remote sensing satellites and their instruments - Vital instrument parameters and sensitivity of instruments - Examples of communication satellites and their instruments - limitations and sensitivity of instruments; Instruments and their capabilities on Atmospheric Science satellites like ENVISAT, Megha-Tropique - Instruments and sensitivities of Astronomy satellites – Hubble Space Telescope, Spitzer Observatory - Chandra X-ray Observatory, Rossi X-ray Timing explorer - Astrosat and Swift mission

## **Semester 2 : 5 papers 200 Marks each**

### ***SAS.201 Magnetosphere (40)***

#### **6.1 Origin of Magnetic Field of Earth (10)**

Dipole Description of Geomagnetic Field –Local elements and their determination - Secular and Diurnal Variation of Geomagnetic Field – Determination of Geomagnetic Coordinates of Station

#### **6.2 Magnetosphere of Earth (10)**

Effects of Solar Wind on Planetary Magnetic Fields – Formation of Geomagnetic Cavity – Magnetopause – Magnetosheath and Bow Shock – Polar Cusp and magnetotail

#### **6.3 Phenomena in Magnetosphere (10)**

Plasmasphere and Van Allen Radiation Belts – Magnetotail Dynamics - Substorms , Aurorae and Storms - Magnetosphere of Other Planets

#### **6.4 Space Weather and its Effects (10)**

Geomagnetic Storms – Sub-storms and Current Systems – Aurora

### ***SAS.202 Solar and Radio Astronomy (40)***

#### **7.1 Elements of Solar Physics (15)**

Sun and its Atmosphere – Solar Magnetic field - Sunspots and Solar Cycles – Solar Flares , Coronal Mass Ejections (CME) and Solar Wind Effect of Magnetic Disturbance on Ionosphere and Thermosphere System - Effects on Space and Ground Based Systems



## **7.2 Solar System Objects and their Exploration (5)**

Planets and satellites of the planets and their orbits - Structure and topography of planets and their satellites - Physical and chemical characteristics - Space imagery of planets and their environment - Comets, asteroids and other minor bodies in the solar system - Their orbits, surface and composition - Comet and asteroid collisions

## **7.4 Basics of Radio Astronomy (10)**

Different type of Radio Telescopes - Aperture Synthesis - Very Long Base Interferometers (VLBI)

## **7.4 Radio Sources (10)**

Radiation Mechanisms, Radio Galaxies, Pulsars, Radio Catalogues

# **SAS.203 Stellar Astronomy (40)**

## **8.1 Introduction to Astronomy (8)**

Celestial Sphere; Coordinate systems; Measurement of Time; Observable quantities; Continuum radiation from Stars; Terminology - Brightness, Luminosity, Magnitude scale, colour; Size and Distance; Stellar spectra - formation of spectral lines - line broadening - curve of growth; Local Thermodynamic Equilibrium - Saha's equation; Spectral classification of stars; HR diagram; Binary stars and determination of stellar parameters.

## **8.2 Introduction to Astrophysics (12)**

Main sequence phase of stars - Energy sources; Equations for Stellar interiors - stability; Atmospheres of stars; Post-main sequence evolution of stars; Fate of stars at the late stages of evolution - Mass loss - Planetary nebulae - supernovae; Chandrasekhar limit - Degenerate core remnants - White Dwarfs - Neutron stars - Black Holes; Interstellar medium and Star formation; Galaxies and their classification; Hubble's law; Introduction to Active Galactic Nuclei and Gamma Ray Bursts

## **8.3 High Energy Astrophysical Processes and Phenomenology (10)**

Radiation processes - Cosmic Rays - Composition, energy and origin - X-ray Sources - X Ray Binaries - Supernova Remnants - Pulsars - Galaxies - Active Galactic Nuclei - Solar X-rays - Gamma-ray astronomy - Gamma-rays from Pulsars - Supernova Remnants and Active Galactic Nuclei - Neutrino astronomy

## **8.4 Astronomical Instruments and Observing Techniques (10)**

Telescopes - Different types of telescopes - Angular resolution and Diffraction Limited Resolution - Image formation in a camera - Plate Scale - Observatories (Ground Based & Space Based) - Focal Plane Instruments—Imagers - Photometers - Spectrometers - CCDs and their use in astronomy - Detectors for Optical, Infrared, UV, X-rays, and Gamma-rays - Effect of Atmosphere (Seeing and Scintillation)

# **SAS.204 Elective Paper 1 (40)**

**Each student will choose the topic of own research interest and pursue the study under the guidance of a research faculty of the institute; prepare the background and the research methodology**

# **SAS.205 Elective Paper 2 (40)**

**Each student will carry out research work on the chosen topic under guidance of a research faculty using observation, analysis, modeling and simulation**

## **Experiments**

In addition to theory classes, participants spend considerable time in carrying out various practical involving laboratory works. In these, they conduct various experiments under supervision of experts at host institution. The Students perform 10 Practical in each Semester. The suggested list of Practical is given below:

### **❖ Semester I:**

1. Measurement of geo-magnetic field
2. Ionospheric Sounding using an Ionosonde/Digisonde
3. Surface Monitoring of Ozone
4. Multi wavelength Airglow Photometer
5. Study of Ionospheric Scintillations
6. Radiation properties of Radio Antenna
7. Optical Depth Measurement Using Filter Photometer
8. Balloon borne measurements of Atmospheric Ozone
9. Total Electron Content measurements using GPS receiver
10. Measurements of Aerosols
11. Airglow Imaging
13. Ultra Sound Velocity
14. Equatorial Anomaly using TVM Data

### **❖ Semester II:**

1. Light Curve of Variable Star
2. Study of Planetary Nebulae
3. Simultaneous study of total ozone, water vapour and aerosol optical depth
4. Radio Pulsar Studies using GMRT/OSRT
5. Study of solar rotation
6. Characterization of X-ray detector
7. Sunspot area and number
8. Solar magnetic field
9. Measurement of Atmospheric Temperature by Nd Yag Lidar
10. Atmospheric Wind by MST Radar
11. Cloud dynamics using Ceilometer
12. Polarization & directivity of Radio Antenna
13. Zonal wind using MST RADAR Data
14. Photo ionization studies using Recoil Ion Momentum Spectrometer

## **PHASE II: ONE YEAR PROJECT**

Each participant after successfully completing Phase-I of the course, will have to carry out an approved project in his/her home country for a period of one year. This is to be formulated jointly by the scholar and his/her advisor at the Centre during Module 3 of Phase I in an area relevant to the interest of the sponsoring institution/ country. The sponsoring institution/country is obliged to guarantee on the return the scholar would remain in a suitable position with commensurate and progressive remuneration and other entitlements for a minimum period of 3 years and will be provided all facilities to carry out the work. This course programme will be considered complete on acceptance/ approval of the submitted project report.



**Centre for Space Science and Technology  
Education in Asia and Pacific (CSSTEAP)**  
(Affiliated to the United Nations)

**APPLICATION FORM FOR 10<sup>TH</sup> POST GRADUATE COURSE IN SPACE AND ATMOSPHERIC  
SCIENCE (AUGUST 1, 2016 TO APRIL 30, 2017)**

**at  
Physical Research Laboratory, AHMEDABAD, INDIA**

**SAS-10**

**(For office use only)**

**Application No.....**

**Date Received.....**

AFFIX PASSPORT  
SIZE  
PHOTOGRAPH

**Important:**

All the correspondence from CSSTEAP (issue of admission letter, e-tickets for travel, enquiries, etc) with the applicants will be on internet and sometimes on phone (Home/ Office), therefore kindly ensure that email-id, phone, fax, etc, are correctly and mentioned.

**(PLEASE TYPE OR USE BLOCK CAPITALS)**

**(1.) Name: (As mentioned in the passport)**

Mr./Ms./Dr.

First

Middle

Last

**(2.) Father's Name:**

**(3.) Name of mother/husband/wife**

**(4.) Date of Birth (dd/mm/yyyy):**

**(5.) Place of Birth**

**(6.) Gender (Male/Female):**

**(7.) Nationality**

**(8.) Contact Information: Present official Address (Valid until date.....)**

Contact number (Please give complete Phone no. with country, city codes)

Office (Tel):

Office (Fax):

Mobile:

E mail:

**Important:**

1. Interested persons may detach last 4 pages from this brochure and use them as Application Form.
2. It is essential that full passport details are mentioned in the Application Form. Application Forms without passport details may not be considered.
3. Providing alternate email-id, phone would ensure timely communication with applicants, specially during urgency/emergency.
4. For faster communication with the applicants CSSTEAP Secretariat will be using your email-id for all purposes (e.g. Admission letter, air tickets and logistic arrangements).
5. Please send an advance copy of the application form duly signed by the nominating or sponsoring agency to the Course Director, Space Science, Physical Research laboratory, Ahmedabad, India by fax (+91-79-2630 2275) or scanned copy via email (uncsc@prl.res.in and vats@prl.res.in) for quick processing. Original copy to be sent through Indian Embassy/High Commission of your country after duly signed by the nominating or sponsoring authority.



**(9.)** Your permanent home address in your country/ contact details (Please give complete phone no. with country and city codes)

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➤Contact number (Please give complete phone no. with country, city codes)

Home (Tel):

Home (Fax):

E mail (alternate preferably Gmail or Yahoo):

**(10.)** Nearest International airport (Specify the place/city):

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**(11.)** Academic Qualifications (mandatory)\*

Degree/(Bachelor /Master) Diploma	Duration of Course(mention from which year to year)	University/ Institution	Year of passing	Grade/ percentage	Major Subjects/ specialization

\*(Enclose copies of Degree/Diploma/Certificates/marks/grades obtained etc. and their certified transcription in English)

➤Major Subject Last Examination:

➤Area of Specialization:

➤Medium of instruction/language:

➤TOEFL Score (Proficiency in English):

Proficiency in English (please tick the option)

Reading: Fair/Good/Very Good

Writing : Fair/Good/Very Good

Spoken : Fair/Good/Very Good

Enclose certified copies of marks/grades of degree, diploma, TOEFL (validity period), etc certificates and their certified translations in English).

**(12.)** DETAILS OF EXPERIENCE AND EMPLOYMENT

➤Present Position/ Designation:

➤Present Responsibilities:

➤Organization and complete Address:

➤Date of Joining this Organization (dd/mm/yyyy):

\*Attach additional sheets giving details of your technical activity during last one year. If necessary

➤Experience during past 15 years:

Name of Organization (s)	Position(s)/ Post (s) held	Nature of work done	Duration

**13(a)** Activities & Projects in which your present organization is engaged (mandatory) and nature of work done or will be done

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**13(b).** Main technical/scientific facilities available in your organization \*(including approximate number and type of computers, type of software available etc.)

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**(14.)** Have you done any other course from CSSTEAP (If yes, please give details including theme and year):

**(15.)** How this Course will help you in your work/organization? Please describe below.

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**(16.)** DETAILS OF PASSPORT: Passport details are essential for selection of candidates and send copy of the passport wherever available.

Passport Number	Place of Issue (City and Country)	Date of issue	Passport valid up to	Issuing Authority	Whether previously visited India if so place and date of last visit

**(17.)** Physical Fitness:

**(a)**Are you suffering from any recurring/chronic/serious communicable disease which may affect your study program in India? Candidates are advised to attach medical fitness certificate from a government hospital or government recognized hospital on hospital letter head for HIV, yellow fever, complete blood test, urine test, blood group, migraine, dental infection, for T.B. chest X-ray, etc.

**(b)**If yes, please specify nature of illness

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**(c)** If necessary you may be asked to undergo necessary medical tests on your arrival, and if participant is found medically unfit then he/she will be asked to return to his/her country and cost of travel will have to be paid either by the sponsoring/nominating organization or by the candidate.

**(18.)** How do you propose to meet the international travel & stay expenses in India? (Preference will be given to those who will make their own travel arrangement)

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**(19.) Declaration by the candidate**

I have read the Announcement brochure and will abide by the rules and regulations of the Centre. I have made / am making/have not made travel arrangements for attending the Course, and for local expenses for the period of stay in India.

Date:

Place:

Signature of the candidate

**(20) SPONSORING / NOMINATING AGENCY CERTIFICATE**

Mr./Ms ..... working in this organization is sponsored (partly or fully) by..... (Ministry/ Department) to attend the 10th Post Graduate Course in **Space and Atmospheric Science**, to be held at **Physical Research Laboratory**, Ahmedabad, India during August 1 , 2016 - April 30, 2017. We envisage to utilize his/her experience in specific tasks of our organization/agency. The candidate will be allowed to carry out a Research Project for a period of one year after his/her return to this country and will be provided with all the facilities required for the same.

**Mandatory: please tick appropriate option:**

(a) He/She will be / will not be provided international travel support.

(b) He/She will be/will not be provided financial assistance for the period of stay in India.

(c) He/She possesses adequate knowledge of English Language required for the course

Date:.....

Signature:

Place:.....

Name in Capital Letters:

Designation:

Phone /Fax No:

E-mail:

**(Official seal of the sponsoring / nominating authority)**

**Note: Application without official seal of sponsoring or nominating authority and their details will not be considered**

**(21) FORWARDING NOTE BY THE RESPECTIVE INDIAN EMBASSY IN YOUR COUNTRY**

This is to forward the application of Mr./Ms.....of .....(specify the country name here) for the 9 months Post Graduate Course in **Space and Atmospheric Sciences** of CSSTEAP, to be held at Physical Research Laboratory, Ahmedabad, India, during August 1, 2016 to April 30, 2017.

Date:.....

Signature:

Place:.....

Name:

Designation:

Phone/Fax No:

E-mail:

**(Official Seal of the Embassy/High Commission of India)**

**N.B.** Please send an advance copy of the application form duly signed by the sponsoring agency to the Course Director, Space and Atmospheric Science, Physical Research Laboratory by fax (+91-79-26302275) for quick processing. Original copy to be sent through Embassy/High Commission of respective country, at New Delhi duly signed by the sponsoring or nominating authority.

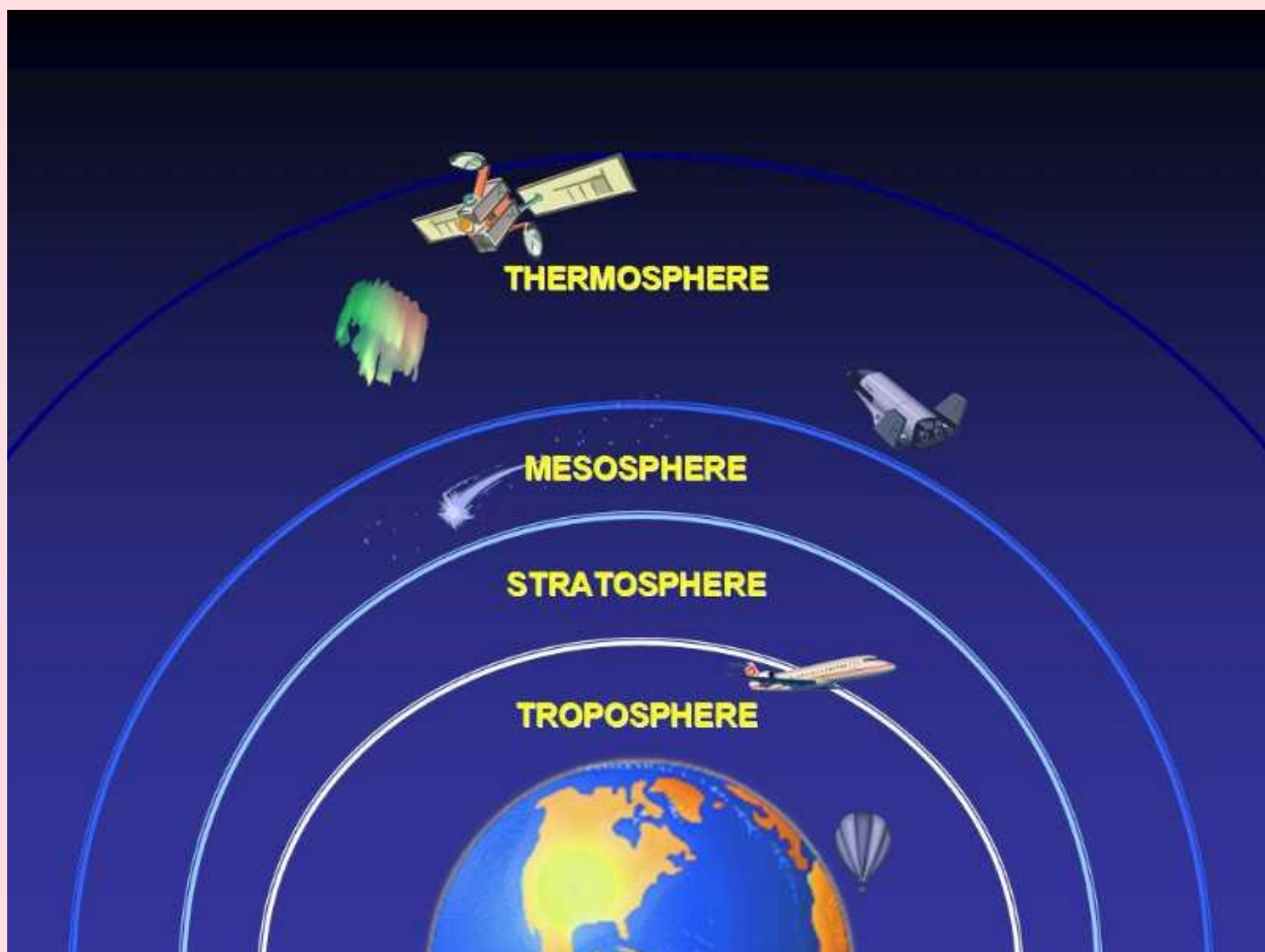
**IMPORTANT**

- The Application which is not complete in all respects is likely to be rejected.
- Smoking and consuming alcoholic drinks in class room and office is prohibited
- Candidates must attach copies of certificates of:
  1. Medical fitness to attend the course including Chest X-ray (PA), Blood Test (including Random Blood Sugar, HIV, HBs, Ag, Urine complete (in case any medical information requiring attention is hidden and if found during the course, the centre will be compelled to send the candidate back home.
  2. Highest degree obtained (Degree certificate and marks sheet/grade card)
  3. Proof of Proficiency in English needs to be provided
  4. All Degree Certificates, if not in English, may please be translated in English and attested by the Head of the organization or transcript in English can also be submitted



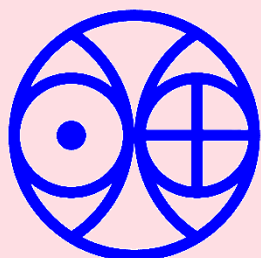






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**[cssteapun@gmail.com](mailto:cssteapun@gmail.com)**  
**Website: [www.cssteap.org](http://www.cssteap.org)**

**Host of Space Science Course**



**Physical Research Laboratory**  
**Navarangapura**  
**Ahmedabad - 380 009 (INDIA)**  
**Email: [uncsc@prl.res.in](mailto:uncsc@prl.res.in)**  
**Tel: +91-79-2630 2275**  
**Fax: +91-79-2630 2275**