


CSSTEAP SHORT COURSE
ON
"Weather Forecasting using Numerical Weather Prediction Models"

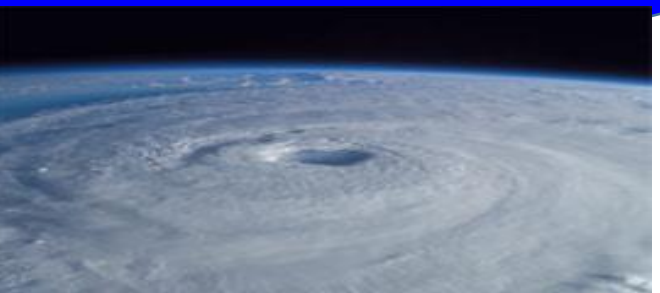
Organized By
CSSTEAP

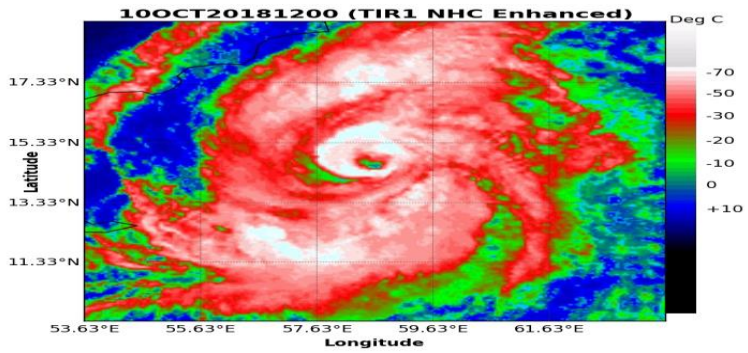
Conducted By
SAC, ISRO


Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP)
(Affiliated to the United Nations)
IIRS Campus, 4, Kalidas Road, Dehradun, India
www.cssteap.org

Space Applications Centre (SAC)
Indian Space Research Organisation (ISRO)
Department of Space, Government of India
Ahmedabad, India
www.sac.gov.in

September 05 –16, 2022



INTRODUCTION

Numerical Weather Prediction (NWP) is the quantitative forecast of weather or climate based on a model or a set of models derived from our “best” understanding of the physical processes that govern the atmosphere or the climate. An NWP model is basically a set of partial differential equations (PDEs) that describe the dynamic and thermodynamic processes in the earth’s environment. The NWP models require initial and boundary conditions that are integrated forward in time to represent and predict the weather. Thanks to the significant developments during past four decades, the Numerical Weather Prediction is now a well recognized discipline of operational sciences that encompasses the elements from various other disciplines such as the computer science, satellite remote sensing, satellite communication, etc.

Today, the skill of NWP forecasts is significantly superior and unmatchable to the manual forecasts. Still, the science of NWP is constantly evolving with innovations in computer technology, improvements in our understanding of physical processes, and the availability of new observations from terrestrial, airborne and space-based platforms. One of the present day challenges of NWP is to understand the nature of biases and errors in the modeling of physical processes as well as in the observations from various sources, and to obtain the most accurate assessment of the state of the present and future weather or climate

Large number of activities, such as transportation, agriculture, national planning, warning against extreme weather conditions, solar and wind power sectors, require in advance, predicted weather information One of the important roles of weather forecasting is to help society about rare and extreme events, such as tropical cyclones, heavy rainfall, high winds, that can cause severe damage and losses of human lives and property. Under the global warming scenario, the frequency of such extreme weather events is expected to increase. The 1999 Odisha cyclone also known as super cyclone was the deadliest tropical cyclone in the Indian Ocean and most destructive Indian storm since 1971. It caused almost 15,000 deaths and made heavy to damage to property. India’s heat wave in 2002 in South India killed more than 1000 people. Most of the deaths occurred in the state of Andhra Pradesh. The 2005 Maharashtra floods occurred just one month after the June 2005, Gujarat floods. Mumbai, the financial capital of India, was most badly affected, and witnessed one of its worst catastrophes in the history of India, killing at least 5,000 people.

On June 2013 Uttarakhand received heavy rainfall, massive landslides due to the large flashfloods causing maximum damage to houses, killing more than 6000 people. In September 2014, the Kashmir region suffered disastrous floods caused by torrential rainfall. In December 2015, Chennai and other parts of Tamil Nadu were severely affected. Villages were completely submerged due to heavy downpour. Okhi Cyclone (Dec-1 -Dec-5, 2017) produced havoc in Sri Lanka and Southern India. Almost 463 people, mostly fisherman and 500 people were missing. Then came Gaja cyclone over Tamil Nadu coast which, killed 45 people and 1,27000 trees was uprooted. The heavy rainfall in Kerala (75% excess of normal) on 8-10 August, 2018 filled all the dams, and 35 of the 54 dams has to be opened resulting in catastrophic flood which resulted in 483 death and huge damage to property and environment. The greatest danger from extreme climate events is likely to be catastrophic in highly populated and poor regions of the world.

Numerical models have now become essential tools in environmental science, particularly in weather forecasting and climate prediction. Numerical Weather Prediction (NWP) uses the powerful computers to make a forecast. Complex computer programs, also known as forecast models, run on supercomputers and provide predictions on many atmospheric variables such as temperature, pressure, wind and rainfall. From theoretical point of view, NWP has to deal with a turbulent fluid whose behavior is governed by a complex set of non-linear, partial differential equations. While from observational point of view, it has the task of facilitating an accurate description of the three-dimensional state of the global atmosphere, which is obtained through the regular and simultaneous observations covering the whole globe from the surface of the earth to upper atmosphere. The NWP models are strongly dependent on the initial state of the atmosphere. Since the availability of the high-speed computer, there has been a growing demand of reliable initial state of atmosphere (temperature, moisture, pressure, and winds) at higher spatial and temporal resolution. Presently, most of the efforts to improve the NWP models forecast accuracy are inclined towards improving the model initial condition. The improved initial condition of a NWP model is obtained through procedure called data assimilation. The purpose of data assimilation is to combine prior information of the atmospheric state, usually taken from previously made forecast, with observations from different platforms to find out the most accurate initial condition for NWP model.

Data assimilation has grown to one of the heaviest investments in NWP. Satellite observations provide global coverage and thus offer invaluable data from areas where no other observations are normally available.

Currently, 90% of the total data used in the operational NWP models comes from space borne observing systems. The increase in the quality and range of satellite observations together with advanced data assimilation techniques and enhanced computational resources has led to significant forecast improvements. As an example, cyclones Nada (during November 2016) and Vardah (during December 2016) roared ashore, flooding towns and villages and destroying tens of thousands of thatched homes. “Phailin” cyclone was the strongest tropical storm to hit India since 1999 Odisha cyclone in which, the loss of human life was minimal (20 people lost their lives). The minimum loss of human lives in case of cyclones Nada and Vardah was because of massive evacuation efforts and improved cyclone track forecast due the extensive use of the space based observations in NWP model. Currently, due to the lack of proper training and expertise, space based observations are under-utilized by NWP community, particularly in Asia Pacific region. Therefore, well trained weather forecasters are needed to utilize the vast amount of satellite data in the NWP models for improved prediction of extreme weather events.

Objectives

The overall objectives of this training course is to generate awareness amongst users/ researchers/professionals/academicians on fundamentals of numerical weather prediction and data assimilation. The participants will be familiarized with the use of numerical weather prediction models, particularly the world’s most widely used model for weather prediction, the Weather Research and Forecasting (WRF). The Mesoscale and Microscale Meteorology (MMM) Division of National Center for Atmospheric Research (NCAR) supports the WRF system to the user community. In addition to this, participants will be made aware of assimilation techniques to make best use of conventional and satellite observations in prediction of extreme weather events.

Eligibility

Master's degree in science or Bachelor's degree in engineering or equivalent qualification relevant in the field of study with at least 5 years of experience in teaching/research or professional experience in the field of atmospheric sciences, satellite meteorology, climate change and weather forecasting (for candidate with higher qualifications, the minimum experience may be relaxed). High School-level knowledge in mathematics and/or statistics is essential besides the master degree as the base qualification. Preference will be given to those who are working in the field of weather forecasting. Nominating agencies may kindly ensure this.

Training Course Duration and Location

The training course will be organized by Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP), and conducted by Space Applications Centre (SAC), Bopal Campus, ISRO, Ahmedabad, India from 05th September – 16th September, 2022.

Language

The medium of the instructions/teaching is English. Proficiency in written and spoken English 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. Nominating agencies are requested kindly to ensure this.

Course Structure

The course is modular in structure and provides a balanced treatment of theory, application and practical experience as follows:

Module 1 (1st week): History of NWP, weather predictions equations, finite differences, time and space discretization, physical processes and parameterizations, forecasting process, forecast verification. Meteorological observations, introduction to data assimilation (optimum interpolation and variational techniques) and ensemble forecasting.

Module 2 (2nd week): Introduction to WRF model, application of WRF model: prediction of extreme weather events (case studies with tropical cyclone, heavy rainfall, and dust storm), data assimilation studies using WRF model (evaluating the impact of different observing networks on the prediction of extreme weather events using WRF model)

Course Implementation/Organization

The course curriculum will be implemented through a mixture of theory and practical, by using state of the art hardware, software and instrumentation facilities. This course will be conducted by the faculty of Space Applications Centre, Ahmedabad, India. The core faculty consists of experienced scientists/engineers working at various centres of Indian Space Research Organization/ Department of Space, Govt. of India. Each participant will be provided access to high-performance computing (HPC) system equipped with WRF model and its data assimilation package to have hands on experience.

Expected Benefits after the Course

After attending this course, the participants are expected to gain theoretical and practical knowledge on numerical weather prediction, particularly the potentials of WRF modeling system for the prediction of extreme weather events various. The participants should be able to use this knowledge in their country for their different applications that will help them set National Disaster management Centre/Unit based on latest technology and trends.

Training Course Fee and Accommodation

A course fee of Rs. 15000 (equivalent to US$ 220) will be charged which includes course materials and field trips. However, tuition fee will be waived off for the candidates sponsored by CSSTEAP. Accommodation for the participants will be arranged in International hostel at SAC Bopal, Ahmedabad. During the stay in Ahmedabad, the participants will be charged Rs. 50/day (in Twin sharing international hostel) towards room rent. The cost of consumables such as cooking gas, eatables, etc. need to be borne by the occupant herself/himself.

Fellowships to Participants

The candidates are required to send their personal details/bio-data to the Associate Course Director, SATMET, Ahmedabad on the prescribed Application Form, appended to this "Announcement Brochure" (or download from website (www.cssteap.org).. Preference will be given to the candidates who are fully or partially financially supported by their organizations/sponsors. A few fellowships covering to and fro international air travel, domestic air travel in India and living expenses (Rs. 8,000 for two weeks) in India are available from Government of India. However, preferences will be given to fully sponsored/self-sponsored candidates bearing international to and fro travel.

Health and Insurance

Medical, Life and disability insurance should be undertaken before leaving their country for India by 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 an 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.

Application Procedure

Dully filled application form attached at the end of this document (can also be downloaded from www.cssteap.org) need to be sent on the contact details given below after endorsement by nominating and/or sponsoring agency. The application form along with education certificates needs to be forwarded either through CSSTEAP Governing Board member in your country (please see details on the website) or through Indian Embassy/High Commission in your country or Your Embassy/High Commission in India. For faster processing the advance (scanned) copy may be sent to us directly either through or email.

About Host Institution – Space Applications Centre, ISRO

Space Applications Centre (SAC), one of the major centers of the Indian Space Research Organisation (ISRO), is responsible for the applications programs of ISRO. It extensively interfaces with the actual users of satellite systems. SAC is active in R & D in the fields of Satellite Meteorology & Oceanography, Remote Sensing and Satellite Communications.

ISRO runs various scientific programme, related to satellite meteorology and oceanography, at Atmospheric and Oceanic Sciences Group of SAC, Ahmedabad. The INSAT series of satellites INSAT-3A, 3D / 3DR (has also sounding capability) geostationary satellites had operational Very High Resolution Radiometers (VHRR), designed and developed at SAC, provide cloud images, winds etc, for cyclone tracking and other weather observations, and temperature and humidity profiles.

IRS-P4 (Oceansat-1) launched in 1999 had a Multi-Channel Scanning Microwave Radiometer (MSMR) besides an Ocean Color Monitor (OCM). Megha Tropiques, a joint collaborative project with

CNES, France, launched in October 2011 carries a MW radiometer, sounder and radiation budget instruments. ISRO has also launched Saral Altika and Oceansat – II / SCATSAT for sea surface for winds, ocean color and ocean circulation studies. These instruments provide inputs to the meteorological and oceanographic observations particularly over the Indian and the Pacific Ocean regions for studying rainfall, El Nino and related phenomena, besides many regional problems like tropical cyclone/hurricane, summer, winter monsoons, etc. ·

Data from the Indian INSAT and IRS satellites and from non-Indian meteorological / oceanographic satellites like NOAA, ERS, SSM /I, MODIS etc. are being utilised by scientists at SAC. Information on Sea Surface Temperature (SST), winds, temperature-humidity profiles, etc. is being retrieved. There is also a very strong programs for using these data in applications in monsoons, tropical cyclones and other important weather phenomena of the region, besides many oceanographic applications, such as gyres, sea mounts, bathymetry, ocean circulation, etc. General Circulation Models in various time scales are being used by assimilating these satellite data for carrying out impact and prediction experiments. Climate research using numerical models and satellite data is one of the thrust areas.

SAC has also established and operationalized a Meteorological and Oceanographic Data Archival Centre (MOSDAC) at its Bopal Campus with a view to disseminating quality data products from ISRO satellite missions on near real time basis and to promote synergy of different sources of satellite data into practical and usable datasets for R&D in atmospheric and oceanic studies. The real-time satellite data from European satellites received through Eumetcast are also used in real-time for WRF model.

ISRO is embarked on the space exploration with Chandrayaan-1 and Mars Orbiter Mission (MOM) with Chandrayaan-2 on pipeline. SAC has significantly contributed in realizing of Chandrayaan payloads and analysing the chandrayaan-1 data. SAC has played key role in developing the payloads for MOM.

About CSSTEAP (Affiliated. to UN) and its Activities

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 considered as the Centre of Excellence by UN-OOSA. 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 Organization (ISRO), Government of India. For conducting its Remote Sensing & GIS programmes 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 programmes related to Satellite Communications, Satellite Meteorology and Global Climate, Global Navigation Satellite Systems and Physical Research Laboratory (PRL) Ahmedabad for Space and Atmospheric Sciences programmes.

The Centre has been imparting training and education, helping participants in developing research skills through its Master Degree, Post Graduate and Certificate programmes. 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 programmes aim at capacity building for participating countries, in designing and implementing space-based research information and application programmes. The Centre also fosters continuing education to its alumni. (http://www.cssteap.org).

Academic Activities

The Centre organizes post Graduate course of 9-months at host institutions of Indian Space Research Organization (ISRO) in the areas of Remote Sensing and Geographic Information System at IIRS, Dehradun; Satellite Communication, Satellite Meteorology and Global Climate and Global Navigation Satellite Systems at Space Applications Centre (SAC), Ahmedabad and Space and Atmospheric Sciences at Physical Research Laboratory (PRL), Ahmedabad. Successful participants also get an opportunity to take up master's programme (Master of Technology degree from Andhra University, Visakhapatnam). The Centre also organizes short courses and on demand special courses for United Nations Agencies like UNSPDER, UNESCAP, UNDP, etc.

Course Duration: 05-16 September, 2022

Announcement of course: July 01, 2022

Last date for submission : July 20, 2022.

Notification of adminissions: July 31, 2022.

CONTACT DETAIL

For course related query candidate may contact

Dr. Sanjib K Deb

(Email: cssteapsatmet@sac.isro.gov.in; Ph: +91-79-26916068)

Atmospheric and Oceanic Sciences Group
Space Applications Centre
Indian Space Research Organization
Ahmedabad-380015,
Gujarat, India

CENTRE FOR SPACE SCIENCE AND TECHNOLOGY EDUCATION IN ASIA AND THE PACIFIC

(AFFILIATED TO THE UNITED NATIONS)

APPLICATION FORM FOR SHORT COURSE ON WEATHER FORECASTING USING NUMERICAL WEATHER PREDICTION MODELS
(05 - 16 SEPTEMBER 2022)
Conducted at
Space Applications Centre, Ahmedabad, India
Last date for receipt of application: July 20, 2022

FE
(for office use only)

Application No.:…….

Date Received :…….

(Please type or use **CAPITAL LETTERS**)

Affix
Recent Passport
size Photograph

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

1. Name (Dr/Mr/Mrs/Miss): ……..…..... (As mentioned in the Passport)

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 what date):

……...

……...

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

Home: ……..…….. Office: ……..……..…….....

Mobile:……

Fax: ……..…….. E-mail: ……..……..……

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Important:
a) Interested persons may detach last 4 pages from this brochure and use them as Application form.
b) It is essential that full passport details are mentioned in the Application Form or provided to the Centre at the earliest.
c) Application Forms without passport details may not be considered.
d) Providing alternate email-id would ensure timely communication with applicants.
e) Please note, 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 arrangement)

9. Permanent home Address (in your country):

……..……..

……..……....

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

Telephone:..……....

Fax: ……...……..……...

E-Mail (alternate, preferably G-mail or Yahoo):……

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

11. ACADEMIC QUALIFICATIONS:

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

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

Major subjects in last examination: ……..…….…….….

Area of Specialization: ……

Medium of Instruction/Language:…….. TOEFL Score: ……

Proficiency in English – tick (√) in appropriate item below:

Reading : Fair, Good, Very Good, Excellent

Writing : Fair, Good, Very Good, Excellent

Spoken : Fair, Good, Very Good, Excellent

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

12. DETAILS OF EXPERIENCE:

(a) Present Position: ……..……..……...

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 (2021-2022)

(b) Experience during past 15 years:

Name of the 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 your duties *

……

……

……

(b) Main Scientific/Technical facilities available in your organization *
(Including approximate number and type of computers, type of software available etc.)

……

……

…… ……..

*If required attach separate sheet.

14. Have you done any other course from CSSTEAP (If 'yes'; please give details including the month & year)

……

……..……..

15. How this course will help you in your work/organization? Please describe below:

……

……..……

16. DETAILS OF PASSPORT: Please provide valid passport details below and if not holding a valid passport, please forward copy of the passport whenever 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 programme in India?

b) If yes, please specify nature of illness (Candidates are advised to attach medical fitness certificate from a government hospital or government recognized hospital on hospital letter head)

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 or both travel and stay arrangement himself/herself).....……..……..……..……

19. DECLARATION BY THE CANDIDATE:

I have read the announcement brochure and will abide by the rules and regulations of the Centre and maintain discipline, harmony and will note indulge in unlawful activities in campus hostel or during educational and field visits. I have made/ am making/ have not made travel arrangements for attending the course and local expenses for the period of stay in India.

Date:

Place: Signature of Candidate

20. SPONSORING / NOMINATING / ENDORSING AGENCY CERTIFICATE:

Dr/Mr./ Ms……..…….... is sponsored/ endorsed by…… to attend the Short Course on Weather Forecasting using Numerical Weather Prediction Models, to be held at Space Applications Centre, Ahmedabad, India during September 05, 2022 – September 16, 2022. We envisage to utilise his/her experience in specific tasks of our organization / agency. The candidate will be allowed to report back to the organization and carryout the project work 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. Following statements are mandatory for certification by the sponsor.

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.

(Mandatory: Please tick appropriate option}

Date :

Place :

Signature:

Name in Capital Letters:
Designation :
Phone No :
Fax No :
Email :

(Official Seal of the sponsoring or nominating authority)

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

21. FORWARDING NOTE BY THE RESPECTIVE INDIAN EMBASSY/HIGH COMMISSION IN YOUR COUNTRY OR YOUR EMBASSY/HIGH COMMISSION IN INDIA, NEW DELHI

This is to forward the application of Dr/Mr. / Ms. ……

of …… (Specify the Country Name here) for the Short Course on Weather Forecasting using Numerical Weather Prediction Models of CSSTEAP to be held at Space Applications Centre, Ahmedabad, India during September 05, 2022 – September 16, 2022.

Date :

Place :

Signature

Name :
Designation:
Phone No:
Fax No :

(Official Seal of the Embassy/High Commission)

Note : **Application without official seal** of the Embassy or High Commission will not be considered

N.B. Please send an advance copy of the application form duly signed by the sponsoring agency to the Associate Course Director, SATMET, Space Applications Centre (ISRO), Ambawadi Vistar P.O, Ahmedabad - 380015, India by fax (+91-79-2691-6078/6075) or Email to **cssteapsatmet@sac.isro.gov.in** for quick processing. Original copy to be sent through Indian Embassy/High Commission of your country after duly signed the sponsor or through your Embassy/High Commission in New Delhi, India.

IMPORTANT

- The Application which is not complete in all respects is likely to be rejected.
- Candidates must attach copies of certificates of:
  a. 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 at the cost of nominating agency or candidate)*.
  b. Attach copy of Highest degree obtained (Degree certificate and marks sheet/grade card)
  c. Proof of Proficiency in English needs to be provided or certificate provided by the nominating agency.
  d. Attach copy of 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.
- Expecting mothers are advised to take a judicious decision before applying and joining the course.
- Smoking and consuming alcoholic drinks in class room, residential area and office campus is prohibited.