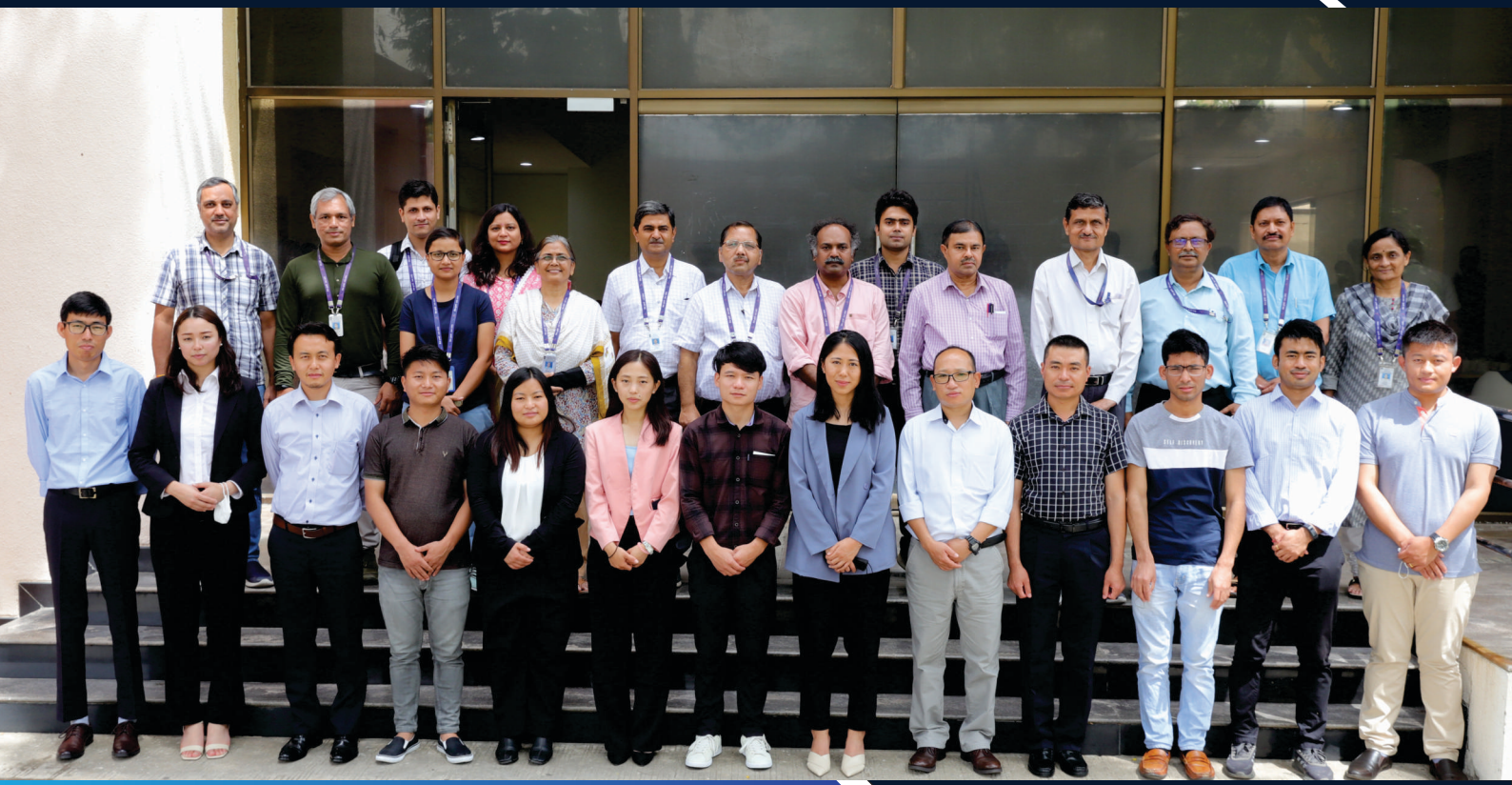
अंतरिक्ष उपयोग केंद्र, इसरो अहमदाबाद
Space Applications Centre, ISRO Ahmedabad

Bhutan Team

Capacity Building

Training Program



BHUTANSAT DATA PROCESSING & ANALYSIS COURSE
SAC, AHMEDABAD, MAY-JULY, 2022

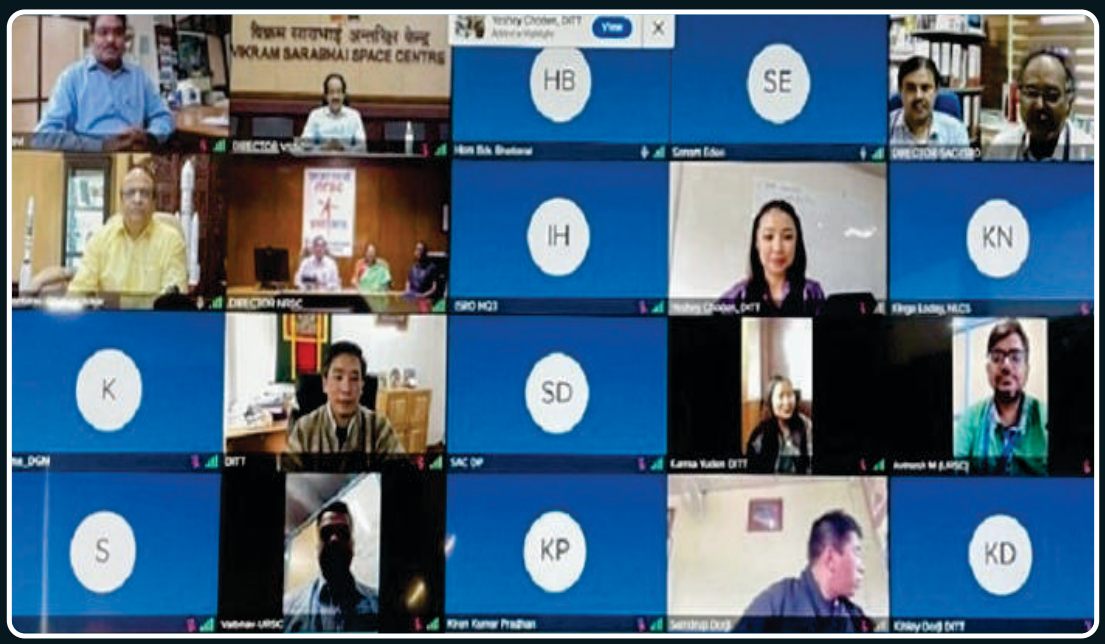
डेकू - इसरो द्वारा डिजाइन
Designed by DECU - ISRO
नवम्बर - 2022
November - 2022

Based on the guidance received from Secretary, DOS/Chairman, ISRO and Director, SAC. Ahmedabad and interactions with the technical team from Bhutan side, training course modules were designed and training was imparted on both theoretical and practical aspects.

Online & Practical modules were designed by Space Applications Centre (ISRO), Ahmedabad.
Course Director: Shri S Manthira Moorthi, Sci/Engr, SAC
Course Duration: 3 Weeks (May'22-Jul'22)

Major Highlights of the Program:

- A one-month **online course** on remote sensing, payloads, mission, data processing and analysis was designed and conducted to include fundamentals and modern concepts of earth observations. Working principles for optical and thermal payloads were covered along with Data reception, Processing and analysis. This training also included Earth Observation data analysis **practical sessions** with specific reference to INS-2TD/2B missions. INS-2TD datasets were used to familiarize the remote sensing data products, their format, and analysis framework though it belonged to thermal remote sensing regime.
- 19 people participated in the online course modules, and 13 people participated in the in-house practical training including 10 participants from Bhutan and 3 from URSC (ISRO), Bengaluru.
- Chairman, ISRO inaugurated online modules on 6th May, 2022. Scientific Secretary-ISRO, Ambassador of India to Bhutan, Director, DITT, Thimphu, Bhutan, Director-SAC, and Directors of other ISRO Centres, MEA officials and Bhutan officials participated in the function.
- Experienced Scientists/Engineers from SAC, URSC, ISTRAC and NRSC delivered theoretical and discipline specific lectures for online module. Topics included remote sensing fundamentals, mission design, sensor design, thermal design for payload operations, orbit and attitude controls for the spacecraft operations, data acquisition from ground stations, coverages, data pre & post processing procedures, and science applications & retrievals.



Inaugural Session with Chairman, ISRO & other dignitaries on 6th May, 2022

- Online module faculties & participants took part from their respective places. Every day a 2-hour session was conducted. Theoretical sessions started on 9th May, 2022 and concluded on 27th May, 2022. Following topics were covered during **Theoretical Sessions,**

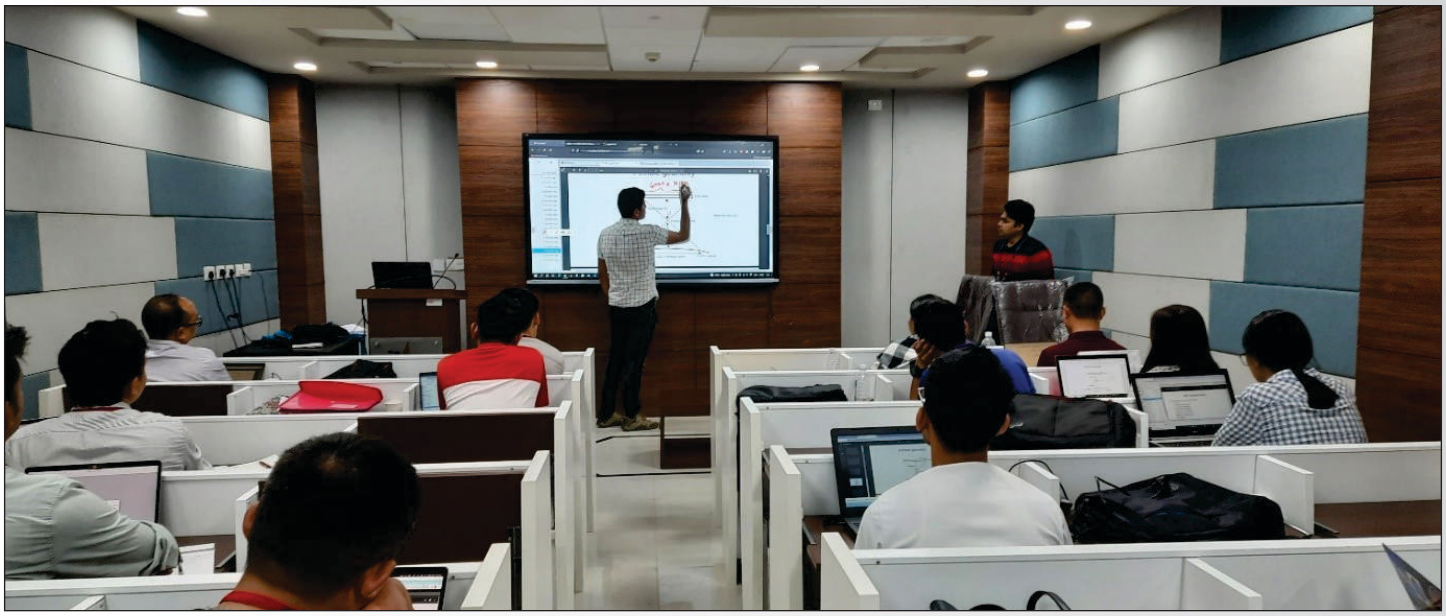
  o Remote Sensing Fundamentals, Payload Engineering: 5 Lectures
  o Remote Sensing Satellites, Mission, Reception and Archive: 5 Lectures
  o Remote Sensing Data Processing and Applications: 5 Lectures

- **Test and quizzes for the theoretical sessions were held online at the end of every week. SAC also designed an online test portal for this purpose.** This online portal authenticated registered participants of the course and allowed to take an exam at a fixed time and date. This test portal was designed such that, users can take this test using mobile screens also.
- **Practical sessions were conducted at SAC with participants staying at Ahmedabad**. A python based data processing and analysis module was designed to provide proof-of-concept exercises. Python Jupyter notebooks were provided for all participants to experiment with data sets. A jupiter hub was setup online for participant's access to datasets and python notebook.

Practicals Inaugural function at SAC on 4th July, 2022

Practical training Participants & SAC Team with Director, SAC

Practical training participants attending the session



Practical training by a faculty with python notebooks & Jupiter hub setup

Practical Sessions: 4-13 July, 2022: Practical Hands-On in "Data Processing & analysis": 5 Sessions

- Essential remote sensing data processing aspects related to Level-0 to Level-1 & 2
- Python programming, optical & thermal data processing, geophysical retrievals and AIML basics with jupyter notebooks.
- LiSS-3 & INS-2TD data sets were used in the practical training. Many Python code segments (Jupyter Notebooks) specially designed for the purpose was provided to experiment & continue their understanding.
- Participants were also trained on geophysical parameter retrievals such as NDVI, NDSI etc. using surface reflectance products.
- **Participation Certificates were provided to all the participants for both theoretical & practical sessions**

19 people participated in online course modules, and 13 people participated in the in-house practical training including 10 participants from Bhutan and 3 from URSC (ISRO), Bengaluru.

General Information:

The participants were accommodated in New SAC Bopal Campus International Hostel during the practical training period. The details of the practical training are provided in Appendix-II.

The participants were facilitated with the visits to SAC Clean Rooms, Technical Facilities and PRL Campus. They were also taken on excursions to various heritage places of Ahmedabad including Gandhi

PRL Visit on 9th July, 2022

Participants experiencing Immersive Display at PLASIV Facility in SAC

Director, SAC Lecture on 13th July, 2022

MRSA Clean Room Visit on 13th July, 2022

Concluding session on 13th July, 2022

Participants interacted with Director, SAC on 13th July, 2022 in the concluding session.

Appendix-I

Online Modules: Bhutansat Data processing & analysis
May-2022

Date, Day & Time	Session Details
1.Inaugural Session	
06th May 2022 (Friday) 12:30 onwards	1. Welcome remarks – Scientific Secretary, ISRO (3 Mins) 2. Inaugural speech – Chairman, ISRO / Secretary DOS (10 Mins) 3. Address by Indian Embassy, Bhutan (5 Mins) 4. Address by Director SAC (5 Mins) 5. Address by DITT, Bhutan (5 Mins) Vote of Thanks – Dr S M Moorthi, SAC, Course Coordinator (2 Mins)
06th May 2022 (Friday) 14:00 to 15:00 hrs.	**Course Introduction by** **Dr. S. Manthira Moorthi, SAC, ISRO** **SAC-POC, Course Director**
2. Remote Sensing Fundamentals, Payloads and Engineering	
09th May 2022 (Monday) 10:00 – 12:00 (IST)	*Fundamentals of Remote Sensing* **Dr. S. Manthira Moorthi, SAC, ISRO** **SAC-POC, Course Director**
10th May 2022 (Tuesday) 10:00 – 12:00 (IST)	*Optical Remote Sensing Payload* **Smt. Moumita Dutta, SAC, ISRO**
11th May 2022 (Wednesday) 10:00 – 12:00 (IST)	*Thermal Infrared Remote Sensing Payload* **Smt. Minal Rohit/Shri Ajay Kumar, SAC, ISRO**
12th May 2022 (Thursday) 10:00 – 12:00 (IST)	*Mechanical Engineering for Remote Sensing Payload* **Shri. Naimesh Patel, SAC, ISRO**
13th May 2022 (Friday) 10:00 – 12:00 (IST)	*Thermal Engineering for Remote Sensing Payload* **Shri. Sandip Somani, SAC, ISRO**
13th May 2022 (Friday) 14:00 – 14:30 (IST)	*weekly online test*

3. Remote Sensing Satellites, Mission, Reception and Archive	
17th May 2022 (Tuesday) 10:00 – 12:00 (IST)	*Indian Nano Satellites (INS) and Beyond* **Shri. Ravi Chandra Babu, URSC, ISRO**
18th May 2022 (Wednesday) 10:00 – 12:00 (IST)	*Indian Nano Satellites (INS) Mission Aspects* **Shri. SVSS Srikanth, URSC, ISRO**
19th May 2022 (Thursday) 10:00 – 12:00 (IST)	*Satellite Data Reception and Acquisition* **Smt. Uma Devi, NRSC, ISRO**
20th May 2022 (Friday) 10:00 – 12:00 (IST)	*Level-0 Data and Orbit/Attitude Processing* **Shri. B. Prabhakaran, URSC, ISRO**
20th May 2022 (Friday) 14:00 – 16:00 (IST)	*Space Science Data Center and Archive* **Shri. Himanshu Pandey, ISTRAC, ISRO**
20th May 2022 (Friday) 14:00 – 16:00 (IST)	*Weekly online test*
4. Remote Sensing Data Processing and Applications	
23rd May 2022 (Monday) 10:00 – 12:00 (IST)	*Data Processing and Product Generation for Optical Remote Sensing Payload* **Shri. Indranil Misra, SAC, ISRO**
24th May 2022 (Tuesday) 10:00 – 12:00 (IST)	*Data Processing and Product Generation for Thermal Infrared Remote Sensing Payload* **Smt. Neha Gaur/Shri. Vivek Sharma, SAC, ISRO**
25th May 2022 (Wednesday) 10:00 – 12:00 (IST)	*AI/ML Applications in Remote Sensing Data Processing* **Shri. Litu Rout, SAC, ISRO**
26th May 2022 (Thursday) 10:00 – 12:00 (IST)	*Optical Remote Sensing Applications: An Overview* **Dr. Bimal Bhattacharya, SAC, ISRO**
26th May 2022 (Thursday) 14:00 – 15:00 (IST) 15:00 hrs – 16:00 hrs	*Snow & Glaciers by* **Sushil Singh, SAC, ISRO** *Forestry applications by* **C P Singh, SAC, ISRO**
27th May 2022 (Friday) 10:00 – 12:00 (IST)	*Thermal Remote Sensing Applications: An Overview* **Dr. Mehul R Pandya, SAC, ISRO**
27th May 2022 (Friday) 15:30 – 16:00 (IST)	*Valedictory session for Theoretical Modules*

Appendix-II
Practical Hands-On in "Bhutansat Data processing & analysis" for Bhutansat Team at SAC, Ahmedabad from
4th July, 2022 to 13th July, 2022
13 participants from Bhutan
Detailed Program

Date	Time (Hrs)	Activity	In charge/Faculty
2rd July 2022	15:10 HRS 6E 2141 flight	Arrival of Bhutan Team from Delhi New Bopal Hostel stay	SMM/Tushar/Indranil
3rd July 2022	10:30 to 13:00	Rest day preparatory meeting	Tushar Bopal Int.Hostel
4th July 2022	10:00 to 11:00	Inaugural Session and High Tea	SMM/Dir. inauguration
	11:00 to 13:00	Python programming exercises	Sunita Arya
	14:30 to 16:30	-do-	-do-
5th July 2022	10:00 to 13:00 14:00 to 16:00	-do-	-do-
	16:00 to 17:00	Visit to facilities in New Bopal Campus	Tushar & Indranil
6th July 2022	10:00 to 13:00	POC-optical Data processing Exercises with LISS3 data	Tushar & Abhishek
	14:30 to 16:30	-do-	-do-
7th July 2022	10:00 to 13:00	-do-	-do-
8th July 2022	10:00 to 13:00	POC-thermal Data Processing with INS-2TD data	Tushar Shukla
	14:30 to 16:30	-do-	-do-
9th July 2022	10:00 to 17:30	Sabarmati ashram, Akshardham and visit Stepwell	SMM, AKS
10th July 2022	Sunday	Holiday	
11th July 2022	10:00 to 13:00	POC-Geophysical Parameter Retrievals	Tushar & Indranil
	14:30 to 16:30	-do-	-do-
12th July 2022	10:00 to 13:00	POC AIML exercises	Litu
	14:00 to 18:30	-do-	
13th July 2022	10:00 to 18:00	Visit to SAC main campus	SEDA, MRSA, PLASIV, VSSE Lunch at VIP
	16:00	Directors presentation	
13th July 2022	16:30 hrs	Valedictory function Awarding certificate High Tea	SMM

Bhutan Team

Capacity Building

Outdoor Image by
Nano-MX Payload of Bhutansat

Training Program

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SAC, Ahmedabad, May-July, 2022

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