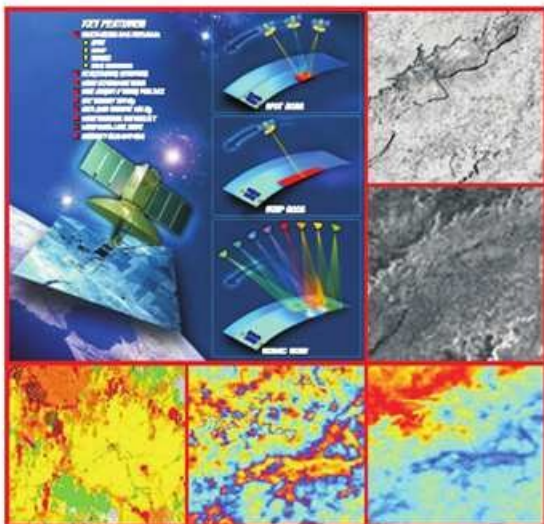


# COURSE REPORT

## INTERNATIONAL TRAINING COURSE ON MICROWAVE REMOTE SENSING AND ITS APPLICATIONS

4<sup>th</sup>-29<sup>th</sup> APRIL 2011



### CSSTEAP

Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP)  
(Affiliated to the United Nations)  
IIRS Campus, Dehradun-248001, India

### CONDUCTED BY



Indian Institute of Remote Sensing  
Department of Space, Govt. of India  
Dehradun, India

### ORGANIZED BY





**Inauguration of the course by Dr. George Joseph, Ex-Director**



**CSSTEAP Participants in the Classroom**



**Inaugural Address by Dr. George Joseph**

# **COURSE REPORT**

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(Affiliated to the United Nations)  
IIRS Campus, Dehradun - 248 001, India**

### **CONDUCTED BY**



**Indian Institute of Remote Sensing  
Indian Space Research Organization, Dehradun, India**

## FOREWORD

The “Regional Centres for Space Science and Technology Education” are established by the efforts of United Nations for Outer Space Affairs (UN-OOSA), to assist in the development of indigenous capacity of each country of the region to apply space science and technology to enhance social and economic development. The first such centre was established for the Asia-Pacific region with India as host country Centre for Space Science and Technology Education for Asia and the Pacific (CSSTEAP). The center has been imparting education/training in the areas of RS & GIS, Satellite Communications, Satellite Meteorology & Global Climate, and Space & Atmospheric Science. This training course is organized as part of the CSSTEAP educational programme to train middle level managers to get in depth theoretical knowledge and on the job training in applying Space Science and Technology for developmental activities.

I am happy that the short course on “*Microwave Remote Sensing and its Application*” has been successfully conducted during the period 4<sup>a</sup> - 29<sup>th</sup> April, 2011, wherein 26 professionals from 16 countries participated in the programme. Apart from lectures the participants were given hands on training on various aspects of microwave data processing and case study demonstrations in different application areas. On behalf of CSSTEAP, I wish to thank staff and faculty members of IIRS for organizing the course at IIRS.

This booklet contains the details of the curriculum followed, the list of faculty and the course participant. I hope the booklet will of use to others who wish to organize similar training course.

**P.S. Roy**  
Director, CSSTEAP

## ACKNOWLEDGEMENTS

An International training course on “**Microwave Remote Sensing and its Applications**” was organized by Center for Space Science and Technology Education in Asia and the Pacific (CSSTEAP) at Indian Institute of Remote Sensing, Dehradun from 4<sup>th</sup> to 29<sup>th</sup> April, 2011.

This course would not have been successful without the support from numerous individuals and institutions. I thank the employers of all 26 participants from 16 countries for deputing their staff to undergo this training program.

Thanks are due to Dr, George Joseph, Ex Director CSSTEAP for gracing the Inaugural function as chief guest and delivering two lectures. In the course the lectures were delivered by expert faculty drawn from various ISRO centers such as Space Application Center (SAC), Indian Institute of Remote Sensing (IIRS), Indian Institute of Technology- Bombay (IIT-B) and regional Remote Sensing Center- North (RRSC-N). We thank the faculty members for sharing their valuable knowledge and experience with the course participants and preparing the lecture and practical material.

Organizing a course needs support from various people. We thank the all the staff and faculty members of IIRS and CSSTEAP for providing their full support and cooperation in successful organizing the course. We would also like to thank Dr. R.S Chatterjee and Praveen Thakur technical team members for their support and cooperation.

We are grateful for the guidance and support of Dr. P.S. Roy, Director CSSTEAP for giving us this opportunity to organize the course. His keen interest, guidance, and supervision have immensely helped us in conduction of the course.

**S.K. Saha**  
Course Director  
Head Agriculture Soils Division

**Shefall Agrawal**  
Course Coordinator  
Head Photogrammetry &  
Remote Sensing

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# International Training Course on

## *Microwave Remote Sensing and ITS Applications*

### Background

The microwave imaging systems from airborne and space borne platforms have been used to map monitor and model earth surface features, natural resources and processes. The potential of such observations is so encouraging from experimental and scientific missions that in recent years several missions are underway to operationalise the microwave imaging technology in various critical application areas including real time monitoring of natural and human induced disasters. Although it is widely envisaged as a complimentary tool to optical remote sensing due to all weather and all time (day and night) imaging capability, it can also be used as a stand lone system by combining temporal and multi-polarisation response of target. Therefore, in the past and recent time, several microwave imaging systems with various combinations of frequency and polarisation have been flown and are planned. The data acquired through Envisat, Radarsat, JERS etc, have been put to several applications in areas of glaciology, hydrology, forestry, geology, meteorology, agriculture and oceanography. Generation of digital elevation models (DEMs), measurement of glacier flows and mapping of deformation due to earthquakes; volcanoes and subsidence are some of the most promising areas of applications. Since it's a ranging system it has capability of detecting movement of the order of mm to m level as demonstrated through numerous examples. Most recently SAR data was used to detect the oil spill in Mumbai caused due to collision of two Panamanian cargo ships off the Mumbai coast. Radarsat SAR data was acquired on 14, 15 and 16<sup>th</sup> August 2010 to study the dynamics of the oil spill in the Thane Creek, Mumbai and its surrounding.

Though there are currently many radar imaging systems its potential has not been fully realized due to various reasons like data and software availability, however the most important reason being lack of trained manpower and considerable efforts need to be put in for effective usage. Keeping this in view the Center for space science and technology

## The Participants

Twenty six professional attended, from 16 countries in Asia Pacific Region namely Bangladesh, China, India, Iran, Indonesia, Kyrgyzstan, Kazakhstan, Malaysia, Mongolia, Phillipines Nepal, Sri Lanka, Tajikistan, Thailand, Uzbekistan, and Vietnam participated in the course. The participants came from different disciplines and organizations. The list of participants, their affiliations and contact details are given in *Annexure 1*.

## Implementation of the Course

### Week 1 (4<sup>th</sup> - 9<sup>th</sup> April)

- Concept and principles of microwave remote sensing
- Passive and Active sensors and Global microwave sensors
- Radar Image Interpretation
- Dielectric properties, roughness and polarization
- Microwave remote sensing
- Microwave remote sensing in India for terrestrial & planetary studies (sensor & design)
- SAR data radiometric and Geometric calibration
- SAR data Feature extraction, filtering and Despeckling
- Optical and Microwave data fusion and Classification
- Principles of InSAR, DEM generation and Analysis procedure

### Week 2 (11<sup>th</sup> - 15<sup>th</sup> April)

- Displacement mapping and parameter retrieval, InSAR (Interferogram, phase unwrapping), InSAR (Geocoding and mosaicing)
- Radar remote sensing in planetary geological studies & Polarimetry
- SAR image Pre processing - raw to Single Look complex (SLC)
- Principles of SAR Polarimetry and Differential interferometry DinSAR

### Week 3 (18<sup>th</sup> - 23<sup>rd</sup> April)

- Microwave RS in characterization of soil resources
- Microwave RS in agriculture studies
- Role of radar remote sensing in soil moisture assessment and monitoring wetland mapping
- Radar remote sensing for crop type identification and mapping



- Microwave interaction with forests and forest type discrimination, mapping and biomass estimation
- Application of SAR in hydrological feature mapping and Snow parameter retrieval, snow and glacier mapping using SAR
- Role of radar remote sensing in Flood monitoring and damage assessment
- Radar applications in ocean studies (Oil slicks, ship detection and sea wind)
- Geophysical parameter retrieval using microwave remote sensing for ocean & meteorological studies
- Radar remote sensing in geomorphological and terrain evaluation
- Radar applications in land subsidence monitoring and change detection analysis
- Radar remote sensing for mapping geological structures and mineral exploration
- InSAR applications in earthquake and landslides

#### Week 4: Case Study (25<sup>th</sup> - 29<sup>th</sup> April)

The participants carried out a small case study on the application of microwave data in the area of their interest and presented the results at the end of the course.

S. No.	Project Title	Name
1.	Four-Component Scattering Power Decomposition with Rotation of Coherency Matrix	Mr. Nguyen Ba Duy
2.	Extraction of Land Use Land Cover Features Using Microwave Data	Mr. Vinay Kumar Ms. Madina Akhmedshina Ms. Vu Thituyet Ms. Tran Thi Huong Giang
3.	Dem Generation From Multi-Frequency InSAR Data And Terrain-Related Applications	Mr. Mohamad Khairul Aswad Mr. Harikrishnan G Mr. Krishna Prasad Bhandari Mr. Gayantha R.L. Kodikara
4.	Polarimetric Decomposition And Semi-Empirical Models For Forest Stem Volume And Biomass Retrieval	Mr. S. Nandy Mr. Sugeng Indarto Ms. Rong Lang Ms. Xue Qing Yang
5.	Flood Mapping And Damage Assessment Using SAR And Optical Remote Sensing	Mr. Md. Masimul Islam Mamun Mr. Mr. Anuchit Sooknarint
6.	Wind Analysis	Ms. Teresa A. Millanes
7.	Retrieval of Sea Surface Height Anomaly From Altimeter Data (SSHA)	Ms. Sijotshoeva Sabzina
8.	Dem Generation Using InSAR	Ms. G.Sarantuya Ms. T.Byambasuren
9.	Soil Moisture Mapping Using ALOS PALSAR Quad-Pol Data	Mr. Bhaskar R. Nikam Mr. Hasan Safarov

S. No.	Project Title	Name
10.	Study Snow Cover Area In Alaknanda River Basin Using ENVISAT ASAR Data	Ms. Pravednaya Viktoriia
11.	Snow Wetness Estimation With Dual Polarization ENVISAT-ASAR Data	Ms. Elena Melnikova
12.	Polarimetric Signature Analysis And Classification of Agricultural Land Targets	Mr. Younes Dehghansoraki
13.	Rain Rate Estimation And Trend Analysis Using TRMM Microwave Imager	Ms. Zhanat Satbeldiyeva
14.	Time Series Analysis TRMM-TMI Precipitation Data Using Complex-EOF (Empirical Orthogonal Function)	Ms. Gulmira Babakhanova

### Practical Exercises

Each participant was provided with individual computer with required image processing software such as ERDAS Imagine, ENVI, ARC GIS, NEST, POLSARPRO, ASF Map Ready, SAR Tools etc. The topics covered in the practical exercises were:

- SAR Data Products
- SAR visual image interpretation
- Dielectric properties, roughness and polarization
- Image pre-processing (calibration and geo-coding)
- Image post-processing (Feature extraction and speckle reduction), data fusion and Classification
- InSAR processing and DEM generation
- Displacement mapping using InSAR processing and Differential Interferometry
- POLSAR processing and SAR applications in planetary geology
- Image pre-processing (raw to SLC)
- SAR Polarimetry and DinSAR
- SAR applications in soil moisture
- SAR applications in forestry
- SAR applications in water resources (flood & snow)
- SAR applications in ocean
- SAR applications in geology and geomorphology
- SAR applications in earthquakes and landslides

### Educational Visit

To familiarize with the rich cultural heritage, diversity and scenic beauty an educational visit to Agra was organized at the end of the course.

## Technical Documents/Software Shared

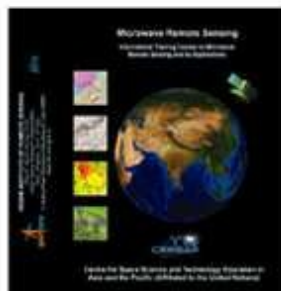
The participants were provided with a DVD consisting of lecture notes, presentation material and open source free software's (NEST, POLSARPRO, ASF Map Ready, SAR Tools etc). They were also provided with the printed volumes (Volume 1- Basic principles of Radar Imaging and Volume 2 on Applications) of the lecture material. The schedule of lectures and practical topics covered are given in *Annexure II*.



Lecture Volume I



Lecture Volume II



DVD (Training Material)

## The Faculty

The lectures were delivered by the experienced faculty drawn from various ISRO centers such as Indian Institute of remote Sensing (IIRS), Space Application Center (SAC) Ahmedabad, National Remote Sensing Center (NRSC), Hyderabad and Regional Remote Sensing Center (RRSC-N), Dehradun and also from National organization such as Indian Institute of Technology Bombay (IIT-B).

The List of faculty and experts who delivered the lectures and conducted practical demonstration is given in *Annexure III*.

## Inaugural and Valedictory Function

The course was inaugurated by Dr. George Joseph, Ex-Director CSSTEAP. The participants introduced themselves, Dr. S.K Saha Course Director welcomed the Chief Guest and the participants, Director CSSTEAP, Dr. P.S. Roy in his address highlighted about CSSTEAP and its activities and also about the significance of Microwave Remote Sensing and this course in particular. Course coordinator Mrs. Shefali Agrawal briefed the participants on the course structure. Dr. George Joseph, Chief Guest of the function in his address expressed the importance of Microwave sensors and its significance in tropical regions and in disaster management, emergency response, Future RADAR imaging missions of India. The valedictory function was held on 29<sup>th</sup> April;



Director CSSTEAP Dr. P.S. Roy awarded the certificates to the participants. In his valedictory address he highlighted on the future Indian and global initiatives on RADAR imaging, challenges in developing smarter, adaptable, and more robust data processing capabilities in order to retrieve information about the imaged terrain at a scale and accuracy commensurate with the needs of environmental and other applications.

### Course Feedback and Recommendations

At the end of the course a formal feedback of the course was taken and each participant was asked to furnish their experiences, view on to the course organization aspect, knowledge gained etc, during the entire course program. All the participants expressed overall satisfaction about the course as it provided a comprehensive overview of microwave remote sensing technology and its application. They appreciated the quality of information content, delivery and practical exercises. However some of them mentioned that the duration of the course could be extended to 6 weeks in order and have more practical classes.

### *Annexure I*

#### List of Course Participants and their details

S. N.	Name	Home country address/ phone/email	Photograph
1.	Md. Mainul Islam Mamun Bangladesh	63, PABA BARA, P.O. Sopura, P.S. Shahmokhdum Dist. Rajshahi, Ph: +8801727226837 Email: mainul_spee@yahoo.com	
2.	Ms. Rong Lang China	Kunming Institute of Botany, Chinese Academy of Sciences, 132, Lanhei Road, Heilongtan, Kunming 650204, Ph: +86-15887087819 Email: langrong@mail.kib.ac.cn	
3.	Ms. Xue Qing Yang China	Kunming Institute of Botany, Chinese Academy of Sciences, 132, Lanhei Road, Heilongtan, Kunming 650704, Ph: +86-15969535773 Email: yxqshasha@gmail.com	

S. N.	Name	Home country address/ phone/email	Photograph
4.	<b>Mr. Bhaskar R. Nikam India</b>	D-4, IIRS, 4, Kalidas Road, Dehradun Mob: 09412198117 Email: bhaskarnikam@gmail.com	
5.	<b>Mr. Harikrishnan G India</b>	Defence Terrain Research Laboratory (DTRL), Defence Research & Development Organization (DRDO) Min. of Defence, Govt. of India, Metcalf House, Delhi, India - 110 054 Ph: 011-23810058 Email: hkgeomatics@gmail.com	
6.	<b>Dr. Subrata Nandy India</b>	Forestry & Ecology Division, Indian Institute of Remote Sensing, Indian Space Research Organization, Dept. of Space, Govt. of India, 4, Kalidas Road, Dehradun, Email: subrato.nandy@gmail.com	
7.	<b>Mr. Vinay Kumar India</b>	B-5, IIRS, 4, Kalidas Road, Dehradun, Mob: 09897800601 Email: vinaybit03@gmail.com	
8.	<b>Mr. Sugeng Indarto Indonesia</b>	Indonesia Agency for Meteorology climatology & Geophysics (BMKG), Remote Sensing Division, 3L, Angkasa 1 No. 2, Jakarta-Indonesia Email: indarto_sugeng@yahoo.co.id Ph: +62-817 270007	
9.	<b>Mr. Younes Dehghansoraki Iran</b>	No. 16th - Gord Afarid Street- North Karegar Street, Tehran, Ph: +989125019247 Email: dehghan.you@gmail.com	
10.	<b>Ms. Gulmira Babakhanova Kazakhstan</b>	RSE, kazhydromet Long-Term Weather Forecast Department, 11/1, Orynbar Str, Astana, Ph: + 77025529469 Email: guma0605@yahoo.com,	

S. N.	Name	Home country address/ phone/email	Photograph
11.	<b>Ms. Zhanat Satbaldiyeva Kazakhstan</b>	RSE, kazhydromet, weather forecasts department, 11/1, Orynbor str, Astana Ph: + 77058153284 Email: zhanatik@yahoo.com	
12.	<b>Ms. Elena Melnikova Kyrgyzstan</b>	Apt. 72, h.6, 7 Micro District Bishkek, Kyrgyzstan, Department of Meteorology, ecology and environment protection, Kyrgyz-Russian Slavic University, Tel: +996 312 555 764-765, Email: elenamelnikova17@gmail.com	
13.	<b>Ms. Viktoriia V Pravednaya Kyrgyzstan</b>	2fl. Asanbai distl Bishkek, Kyrgyzstan Hydro meteorological Agency (Emergency Situation), Tel: (+996555) 7700-79 Email: viiiktoriiia@gmail.com	
14.	<b>Mr. Mohamad Khairol Aswad Bin Mohamad Nazir Malaysia</b>	Malaysian Remote Sensing Agency, No. 13, Jalan Thu Isnail, 50480 Kuala Lumpur, Ph: +60326972656, Email: aswad@remotesensing.gov.my	
15.	<b>Ms. Byambasuren Turtogtokh Mongolia</b>	Lecturer, Department of Geophysical & Geoinformatics, School of Geology and petroleum engineering, Must building No. 1-427 Ph: +976-99008524 Email: byamba03y4@yahoo.com	
16.	<b>Ms. Sarantuya Gonchigjav Mongolia</b>	Lecturer, Department of Geophysical Geoinformatics, School of Geology and petroleum engineering, Must building No. 1-309 Ph: +976 - 91889903 Email: sarang@yahoo.com	
17.	<b>Mr. Krishna Prasad Bhandari Nepal</b>	Western Region campus, Institute of Engineering, Lamachaur, Pokhara-16, Kaski Ph.: 00988-440465, Mob: 00977-9846032668, Email: bhandarikrishna@hotmail.com	



S. N.	Name	Home country address/ phone/email	Photograph
18.	<b>Ms. Teresa A. Millanes</b> <b>Philippines</b>	Philippine Atmospheric, Geophysical & Astronomical Services Administration (PAGASA), Weather Division C/o WFFC Bldg, Bir Road, Diliman, Quezon City, Tel: +6324342592 Email: tessmillanes@yahoo.com	
19.	<b>Mr. Gayantha Roshana</b> <b>Loku Kodikara</b> <b>Sri Lanka</b>	"Chithram" Iuppulla, Akuressa, Sri Lanka Ph.: + 0094415674048 Email: gayantha-kodikam@yahoo.com	
20.	<b>Ms. Sijotshoeva Sabzina</b> <b>Tajikistan</b>	Dushanbe "Weather forecast, hydrometereological (sinoptic) Tel: +992 935317242 Email: mssabrina@mail.zu	
21.	<b>Mr. Hasan Safarov</b> <b>Tajikistan</b>	NCCR-North-South, Dushanbe, Rudaki-avenue, 131, axp-19, Mob: + 992-93-594-32-86 Email: khasan-81@gmail.zu	
22.	<b>Mr. Anuchit Sooknarint</b> <b>Thailand</b>	Bureau of Royal Rainmaking & Agricultural Aviation, 50 Inside Kasetsart University, Ladyao, Jatujak, Bangkok, Thailand - 109000 Email: anuchitsj@yahoo.com Fax: + 662 567 3028	
23.	<b>Ms. Madina</b> <b>Akhmedshina</b> <b>Uzbekistan</b>	11 A Shevchenko Street State Enterprise "Centre of RS & GIS Technologies", Tashkent, Uzbekistan, 100 060, Ph: +99897766-68-95 Email: madina.ahmedshin@gmail.com	
24.	<b>Mr. Nguyen Ba Duy</b> <b>Vietnam</b>	42/302, Lang Street, Dang Da District, Ha Noi, Email: basduy@gmail.com	
25.	<b>Ms. Tran Thi Huong</b> <b>Giang</b> <b>Vietnam</b>	No. 24 Van Cao Street, Lieu Giai, Ba Dinh, Hanoi, Vietnam, Ph: +84466741232 Email: giangde0912@gmail.com	

S. N.	Name	Home country address/ phone/email	Photograph
26.	Ms. Vu Thi Tuyet Vietnam	108 Ghua Lang Street, Dong Da, Hanoi, Vietnam, Mob: +84983328027 Email: tuyetvirila@yahoo.com	

## *Annexure II*

### Course Schedule Short Course on Microwave Remote Sensing and its Application April 4-29, 2011

Date/Time	9:05 - 11:00	11:30 - 13:00	14:00 - 15:00	15:15 - 17:30
04-04-11	(Registration) & Briefing		L1	L2
05-04-11	L3 A 9:05 to 9:55	10:00 to 10:45 Inauguration of course	11:15 -12:30 Lecture by Dr George Joseph	P1
06-04-11	L3 B	L5	P2	
07-04-11	L6 & L7	L8 & L9.	P3	
08-04-11	L10	L11	P4 & P5	
09-04-11	Practice of 1st week Practical exercises			
10-04-11	Sunday			
11-04-11	L12	L13	P6	
12-04-11	HOLIDAY			
13-04-11	L14	L15	P7	
14-04-11	L16	L17	P8	
15-04-11	L18	L19	P9	
16-04-11	Saturday			
17-04-11	Sunday			
18-04-11	L21	L22	P10	
19-04-11	L23	L24	P11	
20-04-11	L25	P13	L26 and P13	
21-04-11	L27	L28	P12	
22-04-11	L29	L30	P15	
23-04-11	L31	Practice of Exercises		
24-04-11	Sunday			
25-04-11	L 20	L32	P16	
26-04-11	Pilot project 26th to 29th April			
28-04-11	Pilot Project			Passing out
29-04-11	Pilot Project presentation			Departure

## LECTURES

S.No	Lecture topic	Faculty
L1	Concept and principles of microwave remote sensing	Mr. Shashi Kumar, IIRS
L2	Passive and Active sensors and Global microwave sensors	Ms. Shefali Agrawal, IIRS
L3A	Radar Image Interpretation	Dr. Samer Saran, IIRS
L3B	Dielectric properties, roughness and polarization	Dr. RS Chatterjee, IIRS
L4	Microwave remote sensing	Dr. George Joseph, Ex Director CSSTEAP
5	Microwave remote sensing in India for terrestrial & planetary studies (sensor & design)	Mr. Nilesh Desai, SAC
L6 & L7	SAR data radiometric and Geometric calibration	Mr. Praveen K. Thakur, IIRS
L8	SAR data Feature extraction, filtering and Despeckling	Mr. Praveen.K. Thakur, IIRS
L9	Optical and Microwave data fusion and Classification	Mr. Praveen.K. Thakur, IIRS
L10 & L11	Principles of InSAR, DEM generation and Analysis procedure	Dr. RS Chatterjee, IIRS
L12 & L13	Displacement mapping and parameter retrieval, InSAR (Interferogram, phase unwrapping), InSAR (Geocoding and mosaicing)	Dr. RS Chatterjee, IIRS
L14 & L15	Radar remote sensing in planetary geological studies & Polarimetry	Dr. Shiv Mohan, SAC
L16 & L17	SAR image Pre processing - raw to Single Look complex (SLC)	Dr. Y.S. Rao, IIT-B
L18 & L19	Principles of SAR Polarimetry and Differential interferometry DinSAR	Dr. Y.S. Rao, IIT-B
L20	Microwave RS in characterization of soil resources	Dr. S.K. Saha, IIRS
L21	Microwave RS in agriculture studies	Dr. Manab Chakraborty, SAC
L22	Role of radar remote sensing in soil moisture assessment and monitoring wetland mapping	Dr. Hari Shankar Srivastava, RRSC-N
L23	Radar remote sensing for crop type identification and mapping	Dr. C. Patnaik , SAC
L24	Microwave interaction with forests and forest type discrimination, mapping and biomass estimation	Dr. S.P.S Kushwaha, IIRS
L25	Application of SAR in hydrological feature mapping and Snow parameter retrieval, snow and glacier mapping using SAR	Mr. Praveen. K. Thakur, IIRS
L26	Role of radar remote sensing in Flood monitoring and damage assessment	Dr. G. Sreenivas Rao, NRSC
L27	Radar applications in ocean studies (Oil slicks, ship detection and sea wind)	Dr. Raj Kumar, SAC
L28	Geophysical parameter retrieval using microwave remote sensing for ocean & meteorological studies	Dr. Raj Kumar, SAC
L29	Radar remote sensing in geomorphological and terrain evaluation	Dr. P.K. Champatiray, IIRS
L30	Radar applications in land subsidence monitoring and change detection analysis	Dr. RS Chatterjee, IIRS
L31	Radar remote sensing for mapping geological structures and mineral exploration	Dr. K.S. Mishra, University of Petroleum
L32	InSAR applications in earthquake and landslides	Dr. P.K. Champatiray, IIRS



## PRACTICAL EXERCISES

S.No	Practical	Faculty
P1	SAR Data Products	Shefali Agrawal/ Shashi Kumar, IIRS
P 2	SAR visual image interpretation	R.S. Chatterjee/ P.K. Thakur, IIRS
P3	Dielectric properties, roughness and polarization	Shashi Kumar, IIRS
P 4	Image pre-processing (calibration and geo-coding)	P.K. Thakur, IIRS
P 5	Image post-processing (Feature extraction and speckle reduction), data fusion and Classification	PK. Thakur, IIRS
P 6	InSAR processing and DEM generation	R.S. Chatterjee/ P.K. Thakur, IIRS
P 7	Displacement mapping using InSAR processing and Differential Interferometry	R.S. Chatterjee, IIRS
P 8	POLSAR processing and SAR applications in planetary geology	Shiv Mohan, SAC/ P.K. Thakur & RS Chatterjee, IIRS
P 9	Image pre-processing (raw to SLC)	Y.S.Rao, IIT-B, P.K. Thakur, IIRS
P 10	SAR Polarimetry and DinSAR	Y.S.Rao, IIT-B/ P.K. Thakur, IIRS
P 11	SAR applications in soil moisture	H. S. Srivastava, RRSC-N/ Mamta Kumari, IIRS
P 12	SAR applications in forestry	Shashi Kumar, IIRS
P 13	SAR applications in water resources (flood & snow )	G. Sreenivas Rao, NRSC/ P.K. Thakur, IIRS
P 14	SAR applications in ocean	Raj Kumar, SAC
P 15	SAR applications in geology and geomorphology	R.S. Chatterjee, IIRS
P16	SAR applications in earthquakes and landslides	P.K. Champatiray / R.S. Chatterjee, IIRS

## LIST OF FACULTY

S.No	Name	Communication Address and email
1	Dr. George Joseph	Honorary Distinguished Professor, ISRO & Former Director CSSTBAP, Space Application Center, Ahembdabad Email: georgejoseph@hotmail.com
2	Mr. Shashi Kumar	Scientist "SC", Geoinformtics Division, Indian Institute of Remote Sensing, 4, Kalidas Road, Dehradun - 248 001 (UK), Dehradun Email: sksiirs@gmail.com
3	Ms. Shefali Agrawal	Head, Photogrammetry & Remote Sensing Division, Indian Institute of Remote Sensing, 4, Kalidas Road, Dehradun - 248 001(UK) Email:shefali_a@iirs.gov.in
4	Dr. Sameer Saran	Scientist "SE", Geoinformatics Division, Indian Institute of Remote Sensing, 4, Kalidas Road, Dehradun - 248 001 (UK) Dehradun Email:sameer@iirs.gov.in
5	Dr. Rajat Chatterjee	Scientist "SF", Geosciences Division, Indian Institute of Remote Sensing, 4, Kalidas Road, Dehradun - 248 001 (UK) Email:rschatterjee@iirs.gov.in
6	Mr. Nileesh Desai	Sci/Engr.- G & Group Director-MSDG/MRSA, Deputy Project Director-RISAT RISAT Building No. 52, Room No. 29, Space Application center, Ambawadi Vistar P.O., Jodhpur Tekra, Ahembdabad - 380 015 Ahembdabad Email:nmdesai@sac.isro.gov.in
7	Mr. Praveen K Thakur	Scientist "SD", Water Resources Division, Indian Institute of Remote Sensing, 4, Kalidas Road, Dehradun - 248 001 (UK) Dehradun Email:praveen@iirs.gov.in
8	Dr. Shiv Mohan	Head, ATTD/RESA, Space Application center, Ambawadi Vistar P.O., Jodhpur Tekra, Ahembdabad - 380 015Ahembdabad Email:shivmohan@sac.isro.gov.in
9	Dr. Y.S. Rao	Associate Professor, Center of Studies in Research engineering, IIT Bombay, Powai, Mumbai - 400 076 Email:ysrao@csre.iitb.ac.in

S.No	Name	Communication Address and email
10	Dr. S.K. Saha	Head, Agriculture & Soils Division, Indian Institute of Remote Sensing, 4, Kalidas Road, Dehradun - 248 001 (UK) Email:sksaha@iirs.gov.in
11	Dr. Manab Chakraborty	Group Director, ATDG/EPISA, Space Application center, Ambawadi Vistar P.O., Jodhpur Tekra, Ahemdabad - 380 015 Email:manab@sac.isro.gov.in
12	Mr. Hari Shankar Srivastava	Scientist "SF", Regional Remote Sensing Center, North, 4, Kalidas Road, Dehradun- 248 001 (UK) Email:hari_space@yahoo.com
13	Dr. C. Patnaik	Scientist, ATDG/EPISA, Space Application center, Ambawadi Vistar P.O., Jodhpur Tekra, Ahemdabad - 380 015 Email: cpatnaik@sac.isro.gov.in
14	Dr. S.P.S. Kushwaha	Head, Forestry & Ecology Division, Indian Institute of Remote Sensing, 4, Kalidas Road, Dehradun - 248 001 (UK) Email:spskushwaha@iirs.gov.in
15	Mr. G. Sreenivas Rao	Scientist, DSC, National Remote Sensing Center, Balanagar, Hyderabad - 500 625 Email:srinivasarao_g@nrsc.gov.in
16	Dr. Raj Kumar	Scientist "SG", OSD, MOG/RESIPA, Space Application center, Ambawadi Vistar P.O., Jodhpur Tekra, Ahemdabad - 380 015 Email:rkumar.sharma@gmail.com
17	Dr. P.K Champati ray	Head, Geosciences Division, Indian Institute of Remote Sensing, 4, Kalidas Road, Dehradun - 248 001(UK) Email:champati_ray@iirs.gov.in
18	Dr. K.S. Mishra	Professor, Department of Petroleum Engineering & Earth Sciences, University of Petroleum, Bidholi Campus Office Energy Acres, P.O. Bidholi Via Prem Nagar, Dehradun - 248 007
19	Ms. Mamta Kumari	Scientist "SC", Agriculture & Soils Division, Indian Institute of Remote Sensing, 4, Kalidas Road, Dehradun - 248 001 (UK) Email:mamta@iirs.gov.in





**Course Participants with Director CSSTEAP and Course Director**



**Course participants at Taj Mahal**

Indian Institute of Remote Sensing  
Department of Space, Govt. of India  
4, Kalidas Road, P. O. Box. 135  
Dehradun- 248 001 (India)

Phone. : +91-135-2744583  
Fax : +91-135-2741987  
Email : [pca@irs.gov.in](mailto:pca@irs.gov.in)  
Website: [www.irs-nrsc.gov.in](http://www.irs-nrsc.gov.in)

Centre for Space Science and Technology  
Education in Asia and the Pacific (CSSTEAP)  
(Affiliated to the United Nations)  
IRS Campus, Dehradun- 248 001 (India)

Phone. : +91-135-2740737/ 2740787  
Fax : +91-135-2740785  
Email: [cssteap@irs.gov.in](mailto:cssteap@irs.gov.in)  
Website: [www.cssteap.org](http://www.cssteap.org)