Course title: Satellite Meteorology			
Course code: NRG 168	**No. of credits:** 3	**L-T-P:** 28-10-14	**Learning hours:** 45
Pre-requisite course code and title (if any):			
Department: Department of Natural and Applied Sciences			
Course coordinator(s): Dr Ayushi Vijhani		**Course instructor(s):** Dr Adil Masood	
Contact details: ayushi.vijhani@terisas.ac.in			
Course type: Core		**Course offered in:** Semester 1	

Course description

Satellite Meteorology refers to the study of earth's atmosphere and oceans using data obtained from meteorological satellites. The analysis of satellite measurements is critical in weather and climate studies and transforming these observations into information is a current challenge in the developing world. The course will provide an introduction to fundamentals of meteorological remote sensing as well as operational and future satellite missions. It will also deal with strength and weaknesses of infrared, visible and water-vapour imagery and estimation of meteorological parameters. The course will further focus on various applications of satellite-derived parameters in meteorology and weather forecasting.

Course objectives

- To provide fundamental understanding about meteorological and atmospheric processes and its associations with coupled human – environment system
- To provide fundamental understanding about current and future satellite missions and numerical weather forecasting
- To utilize satellite based observations to monitor the environment and various meteorological processes/phenomena

Course content

Module	Topic	L	T	P
1.	**Principles of Meteorological Remote sensing** Sun and Atmosphere, Remote Sensing system, Why observe Earth from space, Overview of meteorological satellites, Introduction, History and Evolution, Data need for meteorological studies, Indian scenario Meteorological satellite systems–INSAT series, Meteoset, NOAA, TRMM, DMSP, QUICKSCAT, Megha-Tropiques etc. Forthcoming meteorological missions, Operational and Future satellite missions for aerosols/trace gases measurement	2 2 4		
2.	**Satellite image interpretation** Satellite Image interpretation and enhancement techniques, Cloud type identification, Synoptic scale weather systems, Mesoscale weather systems	4	4	2

3.	**Atmospheric, Land and Ocean Parameter Retrieval** Measurements of atmospheric temperature, Humidity, Aerosols, CO, Ozone, Clouds, Precipitation, Sea Surface temperature, Earth Radiation Budget (ERB), Data assimilation in Numerical models	4		2
4.	**Application of Satellite–derived parameters in Meteorology** Tropical cyclones (satellite tracking of cyclones, Dvorak's technique, genesis and intensity), Extra tropical cyclones, Cyclone warning system in India, Air masses, fronts, Jet streams, Atmospheric Pollutants (Biomass burning aerosols, dust, haze, forest fires etc.) Global Environment, Rainfall variability, Air-Sea interaction (El-Nino, La Nina, ENSO, IOD), Extremes of Temperature and Precipitation (Cold/heat waves, Flood/Drought, Rainfall) Regional/local weather systems Monsoon–Onset, Active/Break cycles, Seasonal monsoon rainfall, Advanced Weather Forecasting	4 2 2	6	6
5.	Case studies highlighting long term climate monitoring and meteorological satellite datasets utilization, Discussion on latest research findings and seminars	4		
5.	Visits to Satellite Meteorology Division, NHAC-IMD and NCMRWF			4
	Total	**28**	**10**	**14**

Evaluation criteria

- Minor test 1: 20% (Module 1-2)
- Minor test 2: 20% (Module 3-4)
- Tutorials/Assignments: 20% (10% each) (All modules)
- Major test 3: 40% (All modules)

Learning outcomes

- Operational and future satellite missions for atmospheric and meteorological parameters (Module 1)
- How satellite images are acquired and interpreted for meteorological applications and weather forecasting (Module 2)
- How atmospheric and meteorological parameters are retrieved and utilized for studying meteorological and atmospheric processes (All modules)

Pedagogical approach

The course will be delivered through class lectures, lab exercise and tutorials.

Materials

Required text 1.

Ahrens C.D. (1999) Meteorology today, Brooks/Cole, 6th edition.
2. Cobb A.B. (2003) Weather Observation Satellites, Rosen Publishing Group.
3. Kelkar R.R. (2007) Satellite Meteorology, B S Publications, Hyderabad.
4. Kidder S.Q. and Vonder T.H. (1995) Satellite Meteorology–An Introduction, Haar Academic Press, New York.
5. Rao P.K. and Ray P.S. (1986) Weather Satellites: Systems, Data and Environmental Applications, American Meteorological Society, Boston.

Suggested Reading

1. Bader M. J., Forbes G.S., Grant J.R., Lilley R.B.E. and Waters A.J. (1995) Images in Weather Forecasting, Cambridge University Press.
2. Barette E.C. and Curtis L.F. (1999) Introduction to Environmental Remote Sensing, Chapman and Hill Publication.
3. Conway E M (2008) Atmospheric Science at NASA: A History, Michener & Rutledge Bookseller, Baldwin City, KS, USA.
4. Menzel P. (1991) W M O Notes on Satellite Meteorology, NOAA/CIMSS.
5. Steven A.A. and John A.K. (2006) Meteorology: Understanding the Atmosphere.

Case studies
Websites

Journals

1. Advances in Meteorology
2. Atmospheric Environment
3. Climate Dynamics
4. International Journal of Climatology
5. International Journal of Remote Sensing
6. Journal of Atmospheric Sciences
7. Journal of Geophysical Research
8. Meteorological Applications
9. Meteorology and Atmospheric Physics
10. Quarterly Journal of Royal Meteorological Society
11. Remote Sensing of the Environment

Additional information (if any)

Student responsibilities: Attendance, Feedback, discipline

Course Reviewers

The course is reviewed by the following experts.

1. Dr Harry Kambezidis, National Observatory of Athens, Athens, Greece.
2. Dr. C.V. Naidu, Dept of Metereology and Oceanography, Andhra University, Visakhapatnam