INTRODUCTION TO ATMOSPHERIC AND SPACE SCIENCES

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IIT Roorkee

TYPE OF COURSE : Rerun | Elective | UG/PG
COURSE DURATION : 12 weeks (24 Jan' 22 - 15 Apr' 22)
EXAM DATE : 23 Apr 2022

PRE-REQUISITES : BSc level Physics / B.Tech (I) level Physics course

INTENDED AUDIENCE : M.Sc (Physics), MSc (Chemistry), MSc (Mathematics), M.Tech (Atmospheric Science), B.Tech (Civil), B.Tech (Mechanical), B.Tech (Chemical), Pre-PhD

INDUSTRIES APPLICABLE TO : ISRO, CSIR, DRDO

COURSE OUTLINE :

This course introduces the basics of Earth's atmosphere to graduate and post-graduate students. It starts from the evolution of atmosphere and gives understanding of various physical and chemical processes responsible for the observed changes we see in weather and climate. It gives a comprehensive understanding of neutral atmosphere, ionosphere and various plasma processes.

ABOUT INSTRUCTOR :

1. M.Sc. (Physics) from Sri Venkateswara University, Tirupati
2. M.Phil (Theoretical High Energy Physics) from University of Hyderabad
3. Ph.D (Atmospheric and Space Physics), IIT Roorkee

Assistant Professor in Physics at IIT Roorkee since 2011.

Prof. Krishna does research in the area of atmospheric and space physics, with specific interest in understanding the space weather effects on the neutral atmosphere and ionosphere by combining satellite, ground based measurements and modeling techniques.

COURSE PLAN :

Week 1 : Atmospheric evolution, solar radiation, present day atmospheric constituents, various stages in the evolution of earth's atmosphere, formation of ozone, carbon budget, oxygen chemistry and life on earth.

Week 2 : Variation of temperature with height, density and ionization with altitude, classification of atmosphere based on temperature and pressure, hydrostatic equation, hypsometric equation

Week 3 : Fundamental forces, non-inertial forces, momentum equations governing the motions in atmosphere, curvature effect, various scales of atmospheric motions.

Week 4 : Hydrostatic equilibrium, hypsometric equation, geopotential height, thermodynamic system, equilibrium state, stability, gas laws, Avogadro hypothesis, gas constant, dry air, mixture of gases, mean molecular mass, humidity variables, moist air, virtual temperature

Week 5 : Enthalpy, adiabatic processes, air parcel, mixing ratio and specific humidity, saturation vapor pressure, relative humidity, dew point, frost point, lifting condensation level, wet-bulb temperature, latent heats

Week 6 : Pseudo-adiabatic processes, equivalent potential temperature, parcel lapse rates, convection of air, collision and coalescence processes, cloud formation, ascent of clouds and types, cloud morphology, cloud classification

Week 7 : Atmospheric stability conditions, Brunt-vaisala frequency, stable, unstable and neutral atmosphere

Week 8 : Cloud seeding and precipitation, Droplet growth, curvature effect and solute effect, radial growth of droplets by diffusion

Week 9 : Earth's upper atmosphere, Ionosphere, various layers and chemistry of ionosphere, types of reactions, Chapman's theory of layer production

Week 10 : Hydrogen in ionosphere, Debye's shielding and Debye's potential

Week 11 : Particle motion in uniform electric field, particle motion in uniform magnetic field and guiding center, particle motion in gradient magnetic fields

Week 12 : Gradient drift and curvature drift, vacuum drift and planetary ring current, magnetic mirroring and loss cone, airglow and aurora.