



INTRODUCTION TO ATMOSPHERIC AND SPACE SCIENCES

PROF. MV SUNIL KRISHNA

Department of Physics

IIT Roorkee

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. This course will introduce the fundamentals of the various interrelations in atmospheric and space physics, the basic scientific methods and techniques.

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.

I carry 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. Our research group at IIT Roorkee tries to understand how intense solar prominences such as solar flares and coronal mass ejections effect the geospace in general and the mesosphere-thermosphere and ionosphere in particular.

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.

LIST OF STUDENTS JOINED AND COMPLETED IN NPTEL ONLINE COURSE (PG)

DEPARTMENT OF PHYSICS

S. No.	Roll. No.	Name of the Student	Name of the Course	Status
1.	21-PP-10	VASANTHA KUMAR E.	Introduction to Atmospheric and Space Sciences	Completed
2.	21-PP-20	KAVIYA K.J.	Introduction to Atmospheric and Space Sciences	Completed
3.	21-PP-27	KIRUTHIKA THANGAVEL	Introduction to Atmospheric and Space Sciences	Completed
4.	21-PP-06	SASIKUMAR K.	Introduction to Atmospheric and Space Sciences	Completed
5.	21-PP-07	SRIRAM P.	Introduction to Atmospheric and Space Sciences	Completed



Dr. T.E. Manjulavalli, M.Sc., M.Phil., Ph.D.,
Assistant Professor and Head
PG & Research Department of Physics
NGM College (Autonomous)
Pollachi - 642 001, Tamil Nadu.



PRINCIPAL
Dr. R. MUTHUKUMARAN.
M.A., M.Phil., B.Ed., Ph.D.,
PRINCIPAL
N.G.M. College, Pollachi - 642 001
Coimbatore District

This certificate is computer generated and can be verified by scanning the QR code given below.

Roll No: NPTEL22PH10S14470675

To
VASANTHAKUMAR E
1/85, MADURAI VEERAN KOVIL ST.
KARUMAPURAM, POLLACHI-642005
COIMBATORE
TAMILNADU - 642005
PH. NO :9698894486



Score	Type of Certificate
>=90	Elite+Gold
75-89	Elite+Silver
>=60	Elite
40-59	Successfully Completed
<40	No Certificate

No. of credits recommended by NPTEL:3

An additional 1 credit may be awarded if the University deems it fit, based on the actual student effort involved.



NPTEL Online Certification

(Funded by the MoE, Govt. of India)



This certificate is awarded to
VASANTHAKUMAR E
for successfully completing the course

Introduction to Atmospheric and Space Sciences

with a consolidated score of **50** %

Online Assignments	19.78/25	Proctored Exam	30/75
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Total number of candidates certified in this course: **87**

Prof. Sanjeev Manhas
Coordinator, Continuing Education Centre
IIT Roorkee

Jan-Apr 2022
(12 week course)

Prof. Priti Maheshwari
NPTEL Coordinator
IIT Roorkee



Indian Institute of Technology Roorkee



This certificate is computer generated and can be verified by scanning the QR code given below.

Roll No: NPTEL22PH10S14471659

To
KAVIYA KJ
86,SUBBAIYAN NAGAR,T.KOTTAMPATTI,
POLLACHI
TAMIL NADU - 642002
PH. NO :9750288541



Score	Type of Certificate
>=90	Elite+Gold
75-89	Elite+Silver
>=60	Elite
40-59	Successfully Completed
<40	No Certificate

No. of credits recommended by NPTEL:3

An additional 1 credit may be awarded if the University deems it fit, based on the actual student effort involved.



Elite

NPTEL Online Certification

(Funded by the MoE, Govt. of India)



This certificate is awarded to

KAVIYA KJ

for successfully completing the course

Introduction to Atmospheric and Space Sciences

with a consolidated score of **63** %

Online Assignments	20.69/25	Proctored Exam	42/75
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Total number of candidates certified in this course: **87**

Prof. Sanjeev Manhas
Coordinator, Continuing Education Centre
IIT Roorkee

Jan-Apr 2022
(12 week course)

Prof. Priti Maheshwari
NPTEL Coordinator
IIT Roorkee



Indian Institute of Technology Roorkee



This certificate is computer generated and can be verified by scanning the QR code given below.

Roll No: NPTEL22PH10S14475227

To
KIRUTHIKA THANGAVEL
6/14B, WEST THOTTAM
UDUKKAMPALAYAM
UDUMALPET
TAMIL NADU - 642207
PH. NO :9655741070



Score	Type of Certificate
≥ 90	Elite+Gold
75-89	Elite+Silver
≥ 60	Elite
40-59	Successfully Completed
< 40	No Certificate

No. of credits recommended by NPTEL:3

An additional 1 credit may be awarded if the University deems it fit, based on the actual student effort involved.



NPTEL Online Certification

(Funded by the MoE, Govt. of India)



This certificate is awarded to

KIRUTHIKA THANGAVEL

for successfully completing the course

Introduction to Atmospheric and Space Sciences

with a consolidated score of **56** %

Online Assignments	20.06/25	Proctored Exam	36/75
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Total number of candidates certified in this course: **87**

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Coordinator, Continuing Education Centre
IIT Roorkee

Jan-Apr 2022
(12 week course)

Prof. Priti Maheshwari
NPTEL Coordinator
IIT Roorkee



Indian Institute of Technology Roorkee



This certificate is computer generated and can be verified by scanning the QR code given below.

Roll No: NPTEL22PH10S14471748

To
SASIKUMAR K
7/8 SOUTH ZONE BLOCK
MAHALINGAPURAM
POLLACHI
TAMIL NADU - 642002
PH. NO :8754708310



Score	Type of Certificate
>=90	Elite+Gold
75-89	Elite+Silver
>=60	Elite
40-59	Successfully Completed
<40	No Certificate

No. of credits recommended by NPTEL:3

An additional 1 credit may be awarded if the University deems it fit, based on the actual student effort involved.



NPTEL Online Certification

(Funded by the MoE, Govt. of India)



This certificate is awarded to

SASIKUMAR K

for successfully completing the course

Introduction to Atmospheric and Space Sciences

with a consolidated score of **56** %

Online Assignments	20.06/25	Proctored Exam	36/75
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NPTEL Coordinator
IIT Roorkee



Indian Institute of Technology Roorkee



This certificate is computer generated and can be verified by scanning the QR code given below.

Roll No: NPTEL22PH10S14475312

To

SRIRAM P
3/19B,SOUTH STREET,VADAKKIPALAYAM(POST)
POLLACHI (TALUK)
POLLACHI
TAMIL NADU - 642110
PH. NO :6369283557



Score	Type of Certificate
≥ 90	Elite+Gold
75-89	Elite+Silver
≥ 60	Elite
40-59	Successfully Completed
< 40	No Certificate

No. of credits recommended by NPTEL:3

An additional 1 credit may be awarded if the University deems it fit, based on the actual student effort involved.



NPTEL Online Certification

(Funded by the MoE, Govt. of India)



This certificate is awarded to

SRIRAM P

for successfully completing the course

Introduction to Atmospheric and Space Sciences

with a consolidated score of **51** %

Online Assignments	21.22/25	Proctored Exam	30/75
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Total number of candidates certified in this course: **87**

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