



University of Kerala

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|----------------|---|------------------|-------------------|--------------------|------------------|
| Discipline | PHYSICS | | | | |
| Course Code | UK3DSEPHY200 | | | | |
| Course Title | FUNDAMENTALS OF EARTH-ATMOSPHERE SYSTEM | | | | |
| Type of Course | DSE | | | | |
| Semester | III | | | | |
| Academic Level | 200 - 299 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 Hr | - | - | 4 Hr |
| Pre-requisites | <ol style="list-style-type: none"> 1. The student should have a general idea about Sun and planets, Elliptical orbits of planets, Tilt of axis of rotation. 2. The student should have a basic knowledge about evaporation and condensation. 3. The students must have observed the changes in daily weather conditions and the optical phenomena like rainbow, mirages. | | | | |
| Course Summary | <p>The course introduces the basics of Earth's atmosphere which is an exact mixture of gases and heat/moisture conditions necessary to sustain life. It starts from the Sun-earth system and gives an understanding about the vertical structure of the atmosphere in terms of temperature, pressure, composition and ionisation. The second module deals with various phenomena associated with clouds and their formation. Different scales of winds and the cause of their generation are given in the third module. The fourth module details the causes of hazardous weather and climate change. Fifth module describes the physics behind the interesting natural phenomena in the atmosphere such as rainbows, mirages, halos etc.</p> | | | | |

BOOKS FOR STUDY:

1. The Atmosphere : An Introduction to Meteorology, Frederick K. Lutgens, Edward J Tarbuck, Dennis Tasa, Pearson., 2018

BOOKS FOR REFERENCE:

1. Basis of Atmospheric Science, A Chandrasekhar, PHI., 2010
2. Atmospheric Science: An Introductory Survey : John M Wallace and Peter V. Hobbs, Academic Press, 2nd Edition, 2006,
3. Essentials of Meteorology: An Invitation to the Atmosphere, C. Donald Ahrens, Cengage, 8th Edition, 2017.

DETAILED SYLLABUS:

| Module | Unit | Content | Hrs | CO No |
|-----------|--|---|-----------|-------|
| I | Earth as a System – Atmosphere of the Earth (Book:1 – Chapter: 1) | | 12 | |
| | 1 | Planetary System | 1 | 1 |
| | 2 | Earth’s motions – Rotation and Revolution, Seasons on the Earth | 2 | 1 |
| | 3 | Earth System – Geosphere, Atmosphere, Hydrosphere, Biosphere – Interactions between various spheres | 1 | 1 |
| | 4 | Composition of the Atmosphere- Major components, trace gases, variable components | 2 | 1 |
| | 5 | Vertical structure of the Atmosphere – Pressure and Temperature changes | 2 | 2 |
| | 6 | Planetary Boundary Layer – definition, nocturnal and diurnal conditions | 2 | 2 |
| | 7 | Charged and neutral atmosphere – Ionosphere and various layers | 2 | 2 |
| II | Forms of Condensation and Precipitation (Book:1 – Chapter: 5) | | 12 | |
| | 8 | Cloud formation | 2 | 3 |
| | 9 | Cloud Classification, Cloud Varieties | 2 | 3 |
| | 10 | Aircraft contrails | 2 | 3 |
| | 11 | Types of fog | 2 | 3 |
| | 12 | Formation of precipitation | 2 | 3 |
| | 13 | Forms of precipitation – Rain, snow, glaze, hail | 2 | 3 |

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|------------|---|---|-----------|---|
| III | Circulations and Winds (Book:1 – Chapter: 7) | | 12 | |
| | 14 | Wind and Air pressure, Temporal and spatial scales of atmospheric motion | 1 | 3 |
| | 15 | Local winds- Land and sea breezes, Mountain and Valley breezes | 1 | 3 |
| | 16 | Monsoons – Asian Monsoon | 2 | 4 |
| | 17 | Westerlies, Jet Streams | 2 | 3 |
| | 18 | Global winds and ocean circulation | 2 | 3 |
| | 19 | El Nino-La Nina-Southern Oscillation | 2 | 4 |
| | 20 | Cyclones, Tornados, Hurricanes | 2 | 4 |
| IV | Hazardous Weather and Climate Change (Book:1 – Chapter: 9,10,11) | | 12 | |
| | 21 | Distinction between Weather and Climate | 1 | 4 |
| | 22 | Air Pollution, Sources of air pollution – anthropogenic and natural | 2 | 5 |
| | 23 | Acid Precipitation | 1 | 4 |
| | 24 | Natural causes of Climate Change- Plate tectonics, Volcanic Activity, Variation of Earth’s Orbit, Solar Variability | 2 | 5 |
| | 25 | Human Impact on Climate Change- Rising CO ₂ levels, Role of trace gases, Role of aerosols | 2 | 5 |
| | 26 | Ozone Depletion | 1 | 5 |
| | 27 | Green House effect, Enhanced Green House effect, Global Warming, Consequences of Global Warming | 2 | 5 |
| | 28 | IPCC, Adaptation and Mitigation | 1 | 5 |
| V* | Optical Phenomena of the Atmosphere (Book:1 – Chapter: 16) | | 12 | |
| | 29 | Interaction of Light and matter – Scattering, Reflection, Refraction, Diffraction, Absorption | 3 | 6 |
| | 30 | Mirages, Rainbows, Glories | 2 | 6 |
| | 31 | Halos, Sundogs, Solar Pillars, Sub Sun | 2 | 6 |
| | 32 | Coronas, Iridescent Clouds | 2 | 6 |
| | 33 | Auroras, Airglow, Alpenglow, Afterglow | 2 | 6 |

COURSE OUTCOMES

| No. | Upon completion of the course the graduate will be able to | Cognitive Level | PSO addressed |
|------|--|-----------------|---------------|
| CO-1 | Remember the basics of Sun Earth System | R | PSO-1,3 |
| CO-2 | Understand the vertical structure of the atmosphere | U | PSO-1,3 |
| CO-3 | Remember the phenomenon of cloud formation and understand the atmospheric circulation | R,U | PSO-1,3 |
| CO-4 | Understand various weather phenomenon | U | PSO-1,3 |
| CO-5 | Understand the changing climate, its causes and impact and apply adaptation and mitigation | U, Ap | PSO-1,3 |
| CO-6 | Remember the interaction of light and matter and Understand various optical phenomenon in the atmosphere | R,U | PSO-1,3 |

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: FUNDAMENTALS OF EARTH-ATMOSPHERE SYSTEM

Credits: 4:0:0 (Lecture: Tutorial: Practical)

| CO No. | CO | PO / PSO | Cognitive Level | Knowledge Category | Lecture (L)/ Tutorial (T) | Practical (P) |
|--------|---|-----------------|-----------------|--------------------|---------------------------|---------------|
| CO-1 | Remember the Basics of Sun Earth System | PO1/ PSO-1,3 | R | F | L | - |
| CO-2 | Understand the vertical structure of the atmosphere | PO1/ PSO-1,3 | U | F, C | L | - |
| CO-3 | Remember the phenomenon of cloud formation and understand the atmospheric circulation | PO1/ PSO-1,3 | R,U | F | L | - |

| | | | | | | |
|------|--|-----------------|-------|------|---|---|
| CO-4 | Understand various weather phenomenon | PO1/ PSO-1,3 | U | C | L | - |
| CO-5 | Understand the changing climate, its causes and impact and apply adaptation and mitigation | PO1/ PSO-1,3 | U, Ap | C | L | - |
| CO-6 | Remember the interaction of light and matter and Understand various optical phenomenon in the atmosphere | PO1/ PSO-1,3 | R,U | F, C | L | - |

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PSO 7 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 |
|------|-------|-------|-------|-------|-------|-------|-------|------|------|------|------|------|------|------|------|
| CO-1 | 1 | - | 1 | - | - | - | - | 1 | - | - | - | - | - | - | - |
| CO-2 | 1 | - | 2 | - | - | - | - | 2 | - | - | - | - | - | - | - |
| CO-3 | 1 | - | 1 | - | - | - | - | 2 | - | - | - | - | - | - | - |
| CO-4 | 2 | - | 2 | - | - | - | - | 2 | - | - | - | - | - | - | - |
| CO-5 | 2 | - | 2 | - | - | - | - | 2 | - | - | - | - | - | - | - |
| CO-6 | 1 | - | 2 | - | - | - | - | 2 | - | - | - | - | - | - | - |

Correlation Levels:

| Level | - | 1 | 2 | 3 |
|-------------|-----|----------------|-------------------|--------------------|
| Correlation | Nil | Slightly / Low | Moderate / Medium | Substantial / High |

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

| CO No | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|-------|---------------|------------|--------------------|---------------------------|
| CO-1 | ✓ | - | - | ✓ |
| CO-2 | ✓ | - | - | ✓ |
| CO-3 | ✓ | - | - | ✓ |
| CO-4 | ✓ | ✓ | - | ✓ |
| CO-5 | ✓ | ✓ | - | ✓ |
| CO-6 | ✓ | ✓ | - | - |