

| <b>Course title:</b> Aerosol Science  |   |  |                           |           |
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| <b>Course code:</b> NRC 133   | <b>No. of credits:</b> 3  | <b>L-T-P:</b> 22-10-20   | <b>Learning hours:</b> 42 |           |
| <b>Pre-requisite course code and title (if any):</b> Basics of climate science or fundamental knowledge of chemistry and physics.   |   |  |                           |           |
| <b>Department:</b> Energy and Environment   |   |  |                           |           |
| <b>Course coordinator(s):</b> Dr Kamna Sachdeva   |   | <b>Course instructor(s):</b> Dr Kamna Sachdeva/ Dr Anu Rani Sharma |                           |           |
| <b>Contact details:</b> Kamna.Sachdeva@terisas.ac.in; anu.sharma@terisas.ac.in  |   |  |                           |           |
| <b>Course type:</b> Elective  |   | <b>Course offered in:</b> Semester 3                               |                           |           |
| <b>Course description</b><br>The aerosols affect visibility, climate, health and quality of life; at the same time their presence in atmosphere assists in the formation of cloud condensation nuclei (CCN). In this context course will focus to understand physical and chemical properties of aerosols, which reflect upon their functional traits in affecting stated atmospheric processes. The course will also include the current understanding about carbonaceous aerosols particles as they are known to impact directly the atmospheric radiative balance, whereby affecting the climate regime. Overview of all the global phenomena affected by or related to aerosols will be discussed in this course. |   |  |                           |           |
| <b>Course objectives</b><br>Upon completion of the course, the student will be able to do the following: <ul style="list-style-type: none"> <li>• To explain the general properties of aerosols and related phenomenon</li> <li>• To understand the optical properties and its role in climate issues</li> <li>• To explain applied aspect of aerosols relevant to climate.</li> </ul>  |   |  |                           |           |
| <b>Course content</b>   |   |  |                           |           |
| <b>Module</b>   | <b>Topic</b>  | <b>L</b>   | <b>T</b>                  | <b>P</b>  |
| 1.  | Module 1: Introduction to atmospheric aerosols<br><br>Atmospheric aerosols its types sources and sinks; chemical characterization of aerosols; radiative effects of aerosols; Aerosol Measurement Techniques  | 6  | 2                         | 6         |
| 2.  | Module 2: Optical properties of Aerosols<br><br>Optical properties of aerosols: refractive index, scattering Albedo, SSA, extinction, diffraction, Rayleigh and Mie scattering. Introduction to OPAC and SBDART, Global Dimming versus Global Warming.  | 6  | 2                         | 8         |
| 3.  | Module 3: Satellite Remote Sensing of Aerosols<br><br>Introduction to satellites monitoring atmospheric aerosols; Atmospheric aerosols retrieval algorithm (Dark target algorithm. Deep blue algorithm etc.) ; Data extraction and visualization (Giovanni, GrADS, HDF view/ Explorer). Major Aerosol Field Campaigns and their findings (ICARB, INDOEX etc.) | 6  | 4                         | 6         |
| 4.  | Module 4: Global issues<br>Health Effects of Aerosols, impact of aerosols on glaciers; vegetation, Impact of aerosols on visibility , Regional and global impact of aerosols  | 4  | 2                         |           |
|   | <b>Total</b>  | <b>22</b>  | <b>10</b>                 | <b>20</b> |

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| <p><b>Evaluation criteria</b></p> <ul style="list-style-type: none"> <li>▪ Tutorials/assignment/practical: 40%</li> <li>▪ Test 1: 20%</li> <li>▪ Test 3 : 40%</li> </ul>  |
| <p><b>Learning outcomes</b></p> <p>Upon successful completion of this course, students will gain a detailed and integrated knowledge of atmospheric aerosols and its effect on regional and global climate. Further they will also be able to critically understand and examine spatial and temporal variation of atmospheric aerosols and its interaction with cloud in the atmosphere.</p>  |
| <p><b>Pedagogical approach:</b> Classroom teaching, Hands on training and field visit</p>   |
| <p><b>Materials</b></p> <p><b>References</b></p> <ol style="list-style-type: none"> <li>1. William C.H (1999) <i>Aerosol Technology: Properties, Behaviour and Measurement of Airborne Particles</i>, 2nd Ed, by <i>John Wiley &amp; Sons</i>.</li> <li>2. Seinfeld J.H. (2002) <i>Atmospheric Chemistry &amp; Physics of Air Pollution</i> by, <i>John Wiley &amp; Sons</i></li> <li>3. Flagan R.C. and Seinfeld J.H., <i>Fundamentals of Air Pollution Engineering</i>, by <i>Prentice Hall</i>.</li> <li>4. Friedlander S., <i>Dust Smoke. and Haze</i>, <i>John Wiley &amp; Sons, 2000</i></li> <li>5. Willeke K. &amp; Baron P. (Ed). <i>Aerosol Measurement: Principles, Techniques and Applications</i>, <i>John Wiley &amp; Sons</i>.</li> <li>6. Gelencser A. (2004) <i>Carbonaceous Aerosols</i>, <i>Springer, Netherlands</i>.</li> <li>7. Wark K., Warner C.F. and Davis W.T. (1998) <i>Air Pollution its Origin and Control</i>, 3<sup>rd</sup> edition, <i>Addison Wesley Longman</i>.</li> <li>8. <a href="#">Stern</a> A.C. (1976) <i>Air Pollution</i>, Volume (I, II, III, IV), <i>Academic Press</i>, London</li> </ol> <p><b>Journals</b></p> <ol style="list-style-type: none"> <li>1. Atmospheric Environment</li> <li>2. Journal Aerosol Science</li> <li>3. Aerosol Science &amp; Technology</li> <li>4. Aerosol &amp; Air Quality Research</li> <li>5. Aerosol Research</li> <li>6. Journal of Geophysical Research</li> </ol> |
| <p><b>Additional information (if any):</b></p>  |
| <p><b>Student responsibilities</b></p> <p>Attendance, feedback, discipline and meeting deadlines</p>  |

## Course Reviewers

Course is commented and reviewed by:

1. Dr. Atul Srivastava, Indian Institute of Tropical Meteorology (IITM), Delhi
2. Dr. Kirpa Ram, Institute of Environment and Sustainable development, Banaras Hindu University (BHU), Varanasi
3. Professor Arun Kumar Attri, SES, JNU, New Delhi
4. Professor Roy Harrison, GEES, University of Birmingham
5. Professor M.M Sarin, PRL Ahmedabad.