Homi Bhabha National Institute
(A Deemed to be University u/s 3 of UGC Act, MHRD & an Aided Institution of DAE)
Anushaktinagar, Mumbai – 400094

On-line Course on

Environmental Modeling

March 18, 2025 to April 26, 2025

Everyday

Time: 10:30 to 11:30 hrs

Course Coordinator: Dr. R. B. Oza

Head, RSSD

Email: rboza@barc.gov.in

Faculty: Dr. R. Shrivastava, RSSD and Dr. Manish Chopra, RSSD

Email: roopa@barc.gov.in; mchopra@barc.gov.in

Target students: Research scholars and faculty members

A: Preamble

Homi Bhabha National Institute (HBNI), a deemed to be University and grant in aid institute of the Department of Atomic Energy has ten constituent Institutions (CI) and one off-campus centre (OCC), which are engaged in fundamental and applied research in basic sciences, mathematics, and engineering sciences. The CI/OCC of the HBNI are engaged in cutting edge and frontline areas of research in different fields. The nature of research in today's times is largely multi-disciplinary and materials form an important component of many research areas across various discipline. This necessitates the knowledge of various aspects of dispersion modeling for young researchers as well as faculty members. In view of this, HBNI is starting an online course on "Environmental Modeling" comprising of 30 lectures (60 minutes duration per lecture). This exhaustive course would cover basics of meteorological measurements in the atmosphere, basic meteorology as well as dispersion modeling in atmospheric, aquatic and sub-surface environments. The course would also help the researchers to appreciate and understand a wide range of research that appears in journals in the field of materials across disciplines. The lectures will be delivered online by experts in the respective subject areas from Bhabha Atomic Research Centre and HBNI (using the Webex platform which will also be available on Youtube).

For any clarifications, please contact Dr. R. B. Oza, Head, RSSD, Course coordinator (rboza@barc.gov.in) or any of the faculty members namely Dr. R. Shrivastava (roopa@barc.gov.in) or Dr. Manish Chopra (mchopra@barc.gov.in).

B: Target Students

Target students for the proposed course are young researchers engaged in PhD and faculty members from different CI/OCI of HBNI as well as other universities.

C. Registration fee structure:

(1) For participants from DAE organisations which are CIs/OCC of HBNI: No registration fee

(2) For participants from DAE organisations that are not CIs/OCC of HBNI: Rs. 500/- (plus applicable taxes)

(3) Participants from non-DAE organisations: Rs. 1000/- (plus applicable taxes)

If the non-DAE candidate wishes to appear for evaluation exam and receive the credit certificate, an additional fee of Rs. 1000/- (plus taxes) would be charged.

D. Course structure: The course will be completed in 30 lectures of 60 minutes each. The course will be of 600 level and will be a **two credits** course for the students for whom the enrolment date for the PhD programme is 01.08.2024, however, for the students for whom enrolment date for the PhD programme is prior to 01.08.2024 the course will have **four credits.**

S. No.	Topic	No. of lectures
1	Meteorological Measurements and Basic Meteorology	8
2	Atmospheric Dispersion Modeling	7
3	Aquatic Dispersion Modeling	8
4	Groundwater Modeling	7

There will be regular assignments and examinations for students who want to earn credit for the course. To earn the credit, the participant should attend more than 75 % of the lectures, and clear the examinations with more than 50% overall marks. Students desirous of participating in the course may please register on AnuVidhya website (www.AnuVidhya.in). Those who meet attendance requirements of 75% but do not take assignments and exam can be given participation certificate by HBNI.

Research scholars who want to earn credits for the course should submit nomination through

the Chairman, Doctoral Committee. The proforma of nomination form is enclosed.

E. Syllabus

(Number of lectures: 30; Duration: 60 Minutes; Number of credits: 2)

Meteorology
The hydrostatic equation, Dry and moist adiabatic lapse rates Nature of solar radiation Thermal boundary layer, Temperature in the lower atmosphere Winds, Wind profile in the surface layer, Mean wind speed Atmospheric stability, Pasquill stability classes, Meteorological analysis, Meteorological instruments, General circulation of the atmosphere.

Atmospheric Dispersion Modelling
Atmospheric dispersion-Advection-Diffusion Equation (ADE), Analytical solution of ADE, Numerical Solution of ADE, Gaussian puff model, Gaussian plume model, particle trajectory model, Removal processes in atmospheric dispersion models-radioactive decay, dry-deposition, wet-deposition Radiological dose assessment using atmospheric dispersion models, plume gamma dose. Submersion and inhalation dose Introduction to meteorological modeling.

Aquatic Dispersion Modelling
Types of aquatic environment–surface water such as rivers, estuaries, lakes, coastal sea, deep sea; and ground water. Fate of contaminants in the aquatic environment-Advection, Diffusion, Dispersion, Chemical and biological processes, Removal processes, Comparative importance of processes: Reynold's number, Peclet number, Damkholer number etc., Dilution factors
Differential equations for simulation of surface water hydrodynamics
Differential equations of solute transport in surface water
Analytical solutions for solute transport in surface water
Numerical solutions for solute transport in surface water
Measurement techniques: Current meters; Tide gauges etc.

The subsurface environment- Unsaturated zone, Saturated zone, Aquifers: unconfined, leaky and confined, Water table; Confining beds, Types of rocks
Differential equations for groundwater flow field simulation
Differential equations of solute transport in groundwater, modeling in-situ progeny production during transport of long-lived radionuclides involving decay chains and its importance in radiological impact assessment, Concept of distribution coefficient and its importance with reference to solute transport in groundwater, Analytical solutions for solute transport equations in groundwater Numerical solutions for solute transport equations in groundwater Geophysical methods for subsurface characterization: Electrical resistivity imaging, Seismic refraction, Field and laboratory based estimation of groundwater flow parameters such as hydraulic conductivity, velocity, recharge, infiltration rate etc.: constant and falling head permeameter, pumping tests, slug tests, tracer tests, double ring infiltrometer. Field and laboratory-based estimation of dispersion parameters.

Suggested references

1. Atmospheric Dispersion Modeling, An Introduction to Boundary Layer Meteorology - Roland B Stull
2. Fundamentals of Atmospheric Modeling – Mark Z Jacobson
3. Atmospheric Chemistry and Physics From Air Pollution to Climate Change, J. H. Seinfeld and S. N. Pandis.
4. Aquatic Dispersion Modeling: Numerical Groundwater hydrology, A. K. Rastogi.
5. Hydrogeology and Groundwater Modeling, Neven Kresic.
6. Groundwater Hydrology, David Keith Todd.
7. Surface Water Quality Modeling, Steven C Chapra.