GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Environmental Management

Subject Code: ME02018061

Subject Name: Environmental Modelling

w.e.f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite:	A basic understanding of environmental science, chemistry, and mathematics
Rationale:	Environmental modeling is a critical tool in understanding, predicting, and mitigating environmental issues.

Course Outcome:

After Completion of the Course, Student will able to:

No.	Course Outcomes
01	Explain scope & the Fundamentals of Environmental Modeling
02	Understand and apply mass balance and control volume concepts, reaction kinetics to model pollutant transport in environmental media.
03	Demonstrate proficiency in applying models to assess water quality in rivers, lakes, and groundwater systems
04	Predict ground level concentration from various pollution sources using air quality models.
05	Utilize GIS and Software Tools in Environmental Modeling

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial/Practical		
L	T	PR	C	ESE (E)	PA/ CA (M)	PA/CA(I)	ESE (V)	
3	0	2	4	70	30	30	20	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	**Introduction:** Overview of Environmental modeling, Scope of Environmental Modeling, Modeling flow chart, Applications and Challenges of Environmental Modeling, types of Environmental models.	04	5 %
2	**Environmental Modeling Concepts:** Overview of pollutant fate & transport phenomena, mass balance concept, control volume approach : steady state solutions, reaction kinetics,Classification of reactors.	06	15 %
3	**Surface Water Quality Modeling:** River types, stream hydrology, Dispersion & mixing in river, Streeter Phelps equation for point source , modifications to Streeter Phelps equation, Dissolved oxygen in rivers, Waste load allocation & River segmentation concept for river modeling Eutrophication of lakes, stoichiometry, phosphorus as a limiting nutrient, mass balance on total phosphorus in lakes,dynamic ecosystem, Models for Eutrophication Assessments	12	30 %
4	**Ground Water Quality Modeling:** Introduction, Darcy's law, flow equations, Contaminant solute transport equation, Bio transformations	07	20 %

5	**Air Dispersion Quality Modeling:** Introduction, basic components & need of air quality modeling, Classification of air quality models, types of air quality models, atmospheric dispersion model flow chart, Gaussian Plume Model for Point, line & area source, its assumptions, advantages& limitation of it. Indoor air quality modeling & simulation, Indoor air quality models & simple modeling techniques.	**10**	**20%**
6	**Applications of GIS & other tools for Environmental Modeling:** Definition of GIS, key components of GIS, function of GIS, advantages and limitation of GIS , applications of GIS for air, surface water & ground water modeling, Various software for Environmental Modeling.	**06**	**10%**
	Total	**45**	**100**

Suggested SpecificationTable with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**30**	**30**	**20**	**05**	**05**

Where R:Remember; U:Understanding; A:Application, N:Analyze and E:Evaluate C:Create(as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Environmental modelling: Fate & transport of pollutants in Water, Air and Soil by Jerald L Schnoor.
2. Environmental Modelling by John Wainwright & Mark Mulligan
3. Modelling the Eutrophication Process by M W Lorenzen
4. Surface water quality modeling by Steven C. Chapra
5. Modeling tools for Environmental Engineers & scientists by N. Nirmalakhandan
6. A basic introduction to Pollutant fate & transport by Frank M. Dunnivant

7. Chemical fate & transport in the Environment by Elizabeth J. Fechner
8. Modeling indoor air pollution by Darrell W Pepper, David B Carrington

(b) Open sources of software and website:

1. **USEPA , BHUVAN , ENVITRANS , LAKS ENVIRONMENT**
2. **https://www.uap-bd.edu/ce/nehreen/Lecture%2010_CE%20433**
3. **http://courses.washington.edu/cewa567/Plumes**
4. **http://lib.unipune.ac.in:8080/jspui/bitstream/123456789/231/8/08_chapter%204**
5. **https://www.sciencedirect.com/science/article/pii/B9780128040409000048**

Suggested Course Practical List:

1. Plot Windrose diagram using WRPLOT software
2. Develop checklist of input data required by AERMOD, ISCST – 3, CALINE, MODFLOW, DESCAR
3. Map the urban settings using QGIS tool.

List of Laboratory/Learning Resources Required:

1. Anemometer
2. Weather monitoring station
3. Indoor air quality monitors

Suggested Activities for Students:

- Case study

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