DEPARTMENT OF CIVIL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY
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COURSE OUTLINE TEMPLATE				
Course Title	**MODELING OF NATURAL SYSTEMS**			
Course Code	CE714		**No. of Credits**	3
Department	Civil Engineering		**Faculty**	Dr. R. Gandhimathi
Pre-requisitesCourse Code	-			
Course Coordinator(s)(if, applicable)	Dr. S. T. Ramesh			
Other Course Teacher(s)/Tutor(s)	-		**E-Mail**	rgmathii@nitt.edu
Course Type		Core		
	√	Program Elective		
		Open Elective		
		Laboratory		

COURSE OVERVIEW

Many environmental problems, such as damage to the biosphere, local air pollution, the spread of harmful substances in the water, and global climatic changes cannot be studied by experimentation. Hence, mathematical models and computer simulations are being used as the appropriate means to get more insight. Surface water quality models can be useful tools to simulate and predict the levels, distributions, and risks of chemical pollutants in a given water body. The modeling results from these models under different pollution scenarios are very important components of environmental impact assessment and can provide a basis and technique support for environmental management agencies to make right decisions. This course will provide the basic concepts of mathematical model development in natural systems such as river, lake, estuaries and air for conservative and non-conservative pollutants, steady state and unsteady state conditions. The simplified models for water quality based on mass balance approach and specific models will be discussed. It also addresses the simple air quality models for point and line sources. The various numerical techniques will also be discussed to solve the flow and transport equations. At the end of the course the students will understand fate and transport of pollutants in natural systems, flow and contaminant transport model development and application of simple modes to predict the air and water quality. Students also learn the numerical techniques to solve the transport equation under transient condition. This will be achieved through descriptive lectures, solving numerical problems and practicing the similar cases through assignment.

COURSE CONTENT (APPROVED IN BoS)

Definition - Classification - Examples of Models for Environmental Systems -Concepts of Scale in Natural Systems - Brief Review of Mass, Momentum and Energy Balance - Transport and fate of pollutant in aquatic systems - Lakes - Rivers - Dissolved oxygen model for streams - Estuaries - Finite Difference and Linear Algebraic Methods to Solve the System Equations - Some Special Models - Introduction to Air Quality Models - Meteorology - Atmospheric Stability and Turbulence - Gaussian Plume Model and Modifications.

References

1. *Chapra, Steven C., Surface water quality modeling, McGraw Hill International Edition, 1997.*
2. *Davis, M.L., and Cornell, D.A. Introduction to Environmental Engineering, McGraw Hill International Editions, 1998.*
3. *Pevy, Rowe, and Techobanoglous, Environmental Engineering, McGraw Hill Publishing company, Newyork, 2007.*
4. *Gilbert M. Masters, Introduction to Environmental Engineering and Science, Prentice- Hall of India Pvt. Ltd., Newdelhi, 3rd Edition, 2007*
5. *Martin, L.J. and McCucheon, S.C, Hydrodynamics of transport for water quality modeling, Lewis Publishers, Boca Raton, 1999.*

COURSE LEARING OBJECTIVES

The objective of the course is,
1. To study the transport and fate of pollutant in natural systems such as lakes, rivers, estuaries and atmosphere
2. To provide an understanding of mathematical model development for natural systems
3. To brief the mass balance approach and some special models for prediction of air and water quality
4. To learn the numerical techniques for solving the system equations

COURSE OUTCOMES (CO)

Course Outcomes

After successful completion of the course, the students should be capable:

CO1	to develop contaminant transport model for natural systems

Aligned Programme Outcomes(PO)

	1	2	3	4	5	6	7	8	9	10	11
CO1	H	H				H			L		M
CO2	H	M	M	M		M			H		
CO3	H	H	H	M		H			M		L
CO4		M	H	M	L	L	L		M	M	M

1. Scholarship of Knowledge 2. Critical Thinking

CO2	to predict the quality of water in river, lakes and estuaries using specific models
CO3	to solve the transport equation using numerical techniques
CO4	to estimate the concentration of pollutant in ambient air using dispersion models

3. Problem Solving	4. Research Skill
5. Usage of modern tools	6. Collaborative and Multidisciplinary work
7. Project Management and Finance	8. Communication
9. Life-long Learning	10. Ethical Practices and Social Responsibility
11. Independent and Reflective Learning	

COURSE TEACHING AND LEARNING ACTIVITIES

Sl. No.	Week	Topic	Mode of Delivery (online through MS Teams)
1.	3rd week of September 2021 **(2 Contact Hour)**	Introduction about air and water quality models. Components of model – classification of models benefits of mathematical models.	Lecture / Writing with Digital Board / Power Point Presentation
2.	4th week of September 2021 **(3 Contact Hours)**	Mass balance equation and problems, Steady state system and Un-steady state system- derivation and problems, Stratification of eutrophic lakes	Lecture / Writing with Digital Board / Power Point Presentation
3.	5th week of September & 1st week of October 2021 **(2 Contact Hours)**	Lake modeling (phosphorous)– settling of pollutant, settling and degradation of pollutant	Lecture / Writing with Digital Board / Power Point Presentation
4.	2nd week of October 2021 **(3 Contact Hours)**	Contaminant Transport Modeling- Basic Laws of Mechanics, Transport Mechanism- Advection, diffusion, dispersion; Derivation: 1 D advection – dispersion equation	Lecture / Writing with Digital Board / Power Point Presentation
5.	3rd week of October 2021 **(3 Contact Hours)**	River pollution- self-purification of streams, Estimation of BOD rate constant and ultimate BOD: Thomas slope method- Fuji motto method- Least square method	Lecture / Writing with Digital Board / Power Point Presentation
6.	4th week of October 2021 **(3 Contact Hours)**	DO deficit, Oxygen Sag curve (deoxygenation curve and re-oxygenation curve - Streeter-Phelps model	Lecture / Writing with Digital Board / Power Point Presentation
7.	5th week of October 2021 **(2 Contact Hours)**	Estimation of critical deficit, critical time, minimum dissolved oxygen; multiple point sources, plotting of oxygen sag curve	Lecture / Writing with Digital Board / Power Point Presentation
8.	2nd week of November 2021 **(3 Contact Hours)**	Waste load allocation- % of treatment - Effect of k_1 and k_2 on oxygen sag curve, Estimation of anaerobic condition in river pollution	Lecture / Writing with Digital Board / Power Point Presentation
9.	3rd week of November 2021 **(3 Contact Hours)**	Estuary modelling: Transport mechanism, Derivation of 1D transport in estuary; Derivation of 1 D transport when there is no flow in river	Lecture / Writing with Digital Board / Power Point Presentation
10.	4th week of November 2021 **(3 Contact Hours)**	BOD and DO estimation (with and without flow in river)	Lecture / Writing with Digital Board / Power Point Presentation
11.	5th week of November 2021 **(3 Contact Hours)**	Finite Difference Method- Explicit method, method; FTBS and FTCS schemes, Numerical stability	Lecture / Writing with Digital Board / Power Point Presentation
12.	1st week of December 2021 **(2 Contact Hours)**	Numerical errors; Numerical dispersion and artificial oscillation; Implicit method- Derivation	Lecture / Writing with Digital Board / Power Point Presentation
13.	2nd week of December 2021 **(3 Contact Hours)**	Air pollution: Stability of the atmosphere, Plume behavior under various conditions of stability, Plume rise	Lecture / Writing with Digital Board / Power Point Presentation

14.	3rd week of December 2021 **(3 Contact Hours)**	Gaussian Model (point source): Estimation of pollutant concentration using Gaussian plume model (point source and line source)-Limitations of Gaussian Model	Lecture / Writing with Digital Board / Power Point Presentation

COURSE ASSESSMENT METHODS

Sl. No.	Mode of Assessment	Week / Date	Duration	% Weightage
1.	Assessment 1	4th week of October 2021	60 Minutes	20%
2.	Assessment 2	4th Week of November 2021	60 Minutes	20%
3.	Quiz (MCQ)	During the session	30 Minutes	10%
4.	Assignments	During the session	-	10%
5.	Term paper (Report & Presentation)	During the session	-	10%
6.	Final Assessment	4th week of December 2021	120 Minutes	30%

Note:

1. Attending all the assessments (Assessment 1 to 6) is MANDATORY for every student.
2. If any student is not able to attend Assessment-1 / Assessment-2 due to genuine reason, student is permitted to attend the compensation assessment (CPA) with 20% weightage (20 marks).
3. At any case, CPA will not be considered as an improvement test.
4. Minimum of 30% should be scored in the final assessment for a pass. The passing minimum for the course shall be maximum of 35% or class average/2.

ESSENTIAL READINGS: Textbooks, reference books Website addresses, journals, etc

1. Chapra and Steven C., Surface Water Quality Modelling, Waveland press, Inc., 2008.
2. Gilbert M. Masters, Introduction to Environmental Engineering and Science, 3rd Edition, Pearson Education Limited, 2013.
3. Davis M. L. and Cornwell D. A., Introduction to Environmental Engineering, Tata McGraw Hill Education Pvt. Ltd, New Delhi, 2010.
4. Pevy, Rowe, and Techobanoglous, Environmental Engineering, McGraw Hill Publishing company, Newyork, 2007.
5. Martin, L.J. and McCucheon, S.C, Hydrodynamics of transport for water quality modeling, Lewis Publishers, Boca Raton, 1999.
6. Wark Kenneth and Warner C.F, Air pollution its origin and control. Harper and Row Publishers, New York, 1997.
7. Rao C.S., Environmental pollution control Engineering, New age international Ltd, New Delhi, 2007.

COURSE EXIT SURVEY (mention the ways in which the feedback about the course is assessed and indicate the attainment also)

The purpose of this survey is to find out from you about your learning experiences and your thoughts about the course. Your replies are very important to assist us in better serving our graduate students. Be assured that your comments will remain absolutely confidential and I will not be able to identify you from other participants.

- Direct feedback from the students by face-to-face meeting individually and as the class as a whole.
- Feedback from the students during class committee meetings
- Exit survey from the students at the end of the session through questionnaire

COURSE POLICY (including plagiarism, academic honesty, attendance, etc.)

DISHONEST / PLAGIARISM

Dishonest / Plagiarism means knowingly presenting another person's ideas, findings or work as one's own by copying or reproducing them without due acknowledgement of the source, with intent to deceive the examiner into believing that the content is original to the student.

Plagiarism is a specific form of cheating which consists of the misuse of the published and/or unpublished works of others by misrepresenting the material (i.e., their intellectual property) so used as one's own work.

ACADEMIC DISHONESTY

a) Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
b) Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.

c) The departmental disciplinary committee constituted with the faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

ATTENDANCE

The attendance will be taken in all the contact hours. Students are encouraged to attend all the classes without absence. Also, the students are encouraged to participate in various co-curricular and extracurricular activities to enrich the academic / campus life.

a) At least 75% attendance in each course is mandatory. Students with less than 75% in any course by the end of 9th week will be identified and alerted by the respective class committees.
b) A maximum of 10% shall be allowed under On Duty (OD) category.
c) Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.

ADDITIONAL COURSE INFORMATION

1. All the students are advised to check their NIT-T webmail regularly to know the updates. All the correspondence (schedule of classes / schedule of assessment / course material / any other information regarding this course) will be communicated through DROPBOX (envnitt@gmail.com).

2. Queries / Clarifications / Discussions (if required) may be E-mailed to me / contact me with prior intimation.

FOR APPROVAL

Dr. R. Gandhimathi	**Dr. J. Karthikeyan**	**Dr. G. Swaminathan**
Course Faculty	**Chairperson (Class Committee)**	**HoD**