GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL (GEOTECHNICAL ENGINEERING) (43)
ENVIRONMENTAL GEOTECHNOLOGY
SUBJECT CODE: 2744302
M.E. 4TH SEMESTER

Type of course: Master of Engineering

Prerequisite: 1. Soil Mechanics and Foundation Engg (Geotechnical Engineering I&II).

2. Foundation Engg (Geotechnical Engineering II) including knowledge of IS codes on foundation

Rationale: Geotechnical engineering has evolved as a highly multidisciplinary subject for the past few decades, dealing with a wide range of geo-hydro-chemico-mechanical problems. The subject has grown far beyond the conventional problems and a geotechnical engineer need to deal with environmental problems related to the reduction of waste, waste disposal facilities and cleanup of contaminated sites.

To effectively take up these new challenges, there is a need to acquaint with the knowledge of soil physics, soil chemistry, hydrogeology, and biological processes along with the principles of soil mechanics.

The course on E*nvironmental Geotechnology* is a blend of geotechnical engineering and environmental concepts and introduces multidisciplinary problem domains to the post graduate students with latest field practices and codal provinces. Case histories are discussed to exemplify the importance of this subject in the current age of rapid industrialization and urbanization. This will help them to analyze, design and execute suitable landfill systems and waste management w.r.t various types of domestic and industrial contaminants.

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Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks		Practical Marks				
L	T	P	C	ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	0	4	70	30	30	0	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction & Soil-Contaminant Interaction:** Need of environmental geotechnology, role of soil and its various phases in geoenvironmental engg, Environmental cycles and their interaction - soil water environment interaction relation to geotechnical problems - pollution effect on soil behaviour and foundations -effect of bacteria - pore fluid on soil water behaviour -load factor versus environmental factor -environmental technology and public concerns, case studies	06	15
2	**Site Selection & Disposal of Waste:** characterization of land fill sites – waste characterization – stability of land fills – current practice of waste disposal -criteria for geotechnical construction on sanitary landfills - liners – types and design - passive containment systems-leachate contamination- land fill gases and their properties, landfill gas monitoring systems - application of geo-synthetics	06	25

	in solid waste management.		
3	**Transport of Contaminants:** Contaminant transport in sub surface – advection – diffusion – dispersion – governing equations – contaminant transformation – sorption – biodegradation – ion exchange – precipitation – hydrological consideration in land fill design – ground water pollution – bearing capacity of compacted fills – foundation for waste fill ground – Case studies	08	20
4	**Impact of Environmental Issues:** Environmental effects caused by pile driving and their control -dynamic response of soil under environmental stress -contribution of environmental stress such as hazardous waste -acid rain, tree cutting etc. to mechanism of landslides	05	20
5	**Remediation Measures:** Remediation methods for soil and groundwater – selection and planning of remediation methods, bio – remediation, incineration, soil washing, electro kinetics, soil heating, – some examples of in-situ remediation.	07	20

Reference Books:

1. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.
2. Daniel, B.E., Geotechnical Practice for waste disposal, Chapman and Hall, London, 1993.
3. Proceedings of the International symposium of Environmental Geotechnology (Vol.I and II), Environmental Publishing Company, 1986 and 1989.
4. Ott, W.R., Environmental Indices, Theory and Practice, Ann. Arbor, 1978.
5. Hsai-Yang Fang, "Introduction to Environmental Geotechnology", CRC Press, New York
6. ASTM Special Technical Publication 874, Hydraulic Barrier in Soil and Rock, 1985.
7. Westlake, K., (1995), Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995.
8. Lagrega, M.d., Buckingham, P.L., and Evans, J.C., Hazardous Waste Management, McGraw Hill, Inc. Singapore, 1994.
9. Edward A., McBean, Frank A. Rovers "Solid Waste Landfill Engineering and Design", Prentice Hall PTR.
10. Zheng C., "Applied Contaminant Transport Modeling", John Wiley & sons, First edition.

Course Outcome:

After learning the course the students should be able to:

1. Understand the important characteristics of the waste containment and remediation industry, the responsibilities of a geotechnical engineer in this field, and the potential areas for improvement, know the relevant governmental regulations and engineering design requirements
2. Understand the difference between hazardous and solid waste, plan the lifecycle of a waste containment facility, evaluate the impact of contaminants on the properties of soils and geosynthetics
3. Perform an experiment to evaluate the hydraulic conductivity of a saturated soil Analyze flow through soil layers, plan and perform an experiment to evaluate the SWRC of an unsaturated soil, analyze flow through unsaturated soils, partition mass of contaminants into air-water-solid phases, calculate rates of diffusion and advection through soils and geosynthetics
4. Check the compaction quality using field tests, evaluate the success of clay liner installation, evaluate difference in flow through geomembranes and composite liners
5. Design a drainage system to reach regulatory requirements, evaluate the difference between soil and geosynthetic drains, landfill cover systems, interpret hydraulic performance of alternative landfill covers given different climatic conditions, calculate rates of gas flow through soil covers, analyze the stability of a landfill liner and cover

List of Tutorials:
Design of landfill and selection of landfill site for each type of waste as per codal environmental clauses and supported by at least two case studies. Maximum no of problems may be equal to 10-15.

Few examples of the same are given below:
1. Make detail spreadsheet of classification of waste of your local city including both dry and wet waste.
2. Selection of sites for waste dumping based on sub soil profile and design of suitable landfill cover using local materials and geosynthetics.

Major Equipment:

Computer system with latest hardware, Programming language C/C++/Java, MATLAB, SIMULINK

List of Open Source Software/learning website:

- http://nptel.ac.in/
- http://ocw.mit.edu/courses/civil-and-environmental-engineering/

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.