1. COURSE TITLE

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Analysis and Design of Concrete Dams, 20-670

2. INSTRUCTORS

- Lecturer: M. Ghaemian (http://sharif.ir/~ghaemian/) Room: 417 Ext. 4240
- Teaching Assistant:

3. COURSE OUTLINE

Definition of dam, types of dams, stability of dams, reservoir and its equation of motion; boundary conditions, Fluid-structure interaction, Finite element modeling of the dam-reservoir system, Dynamic analysis of the dam reservoir system, Nonlinear fracture models of concrete gravity dams, Experimental studies of small scale dam models, Seismic retrofitting of concrete dams, Hydroseismic Isolation, Alkali Aggregate Reaction (AAR)

4. CLASS-HOURS

Three (3) hours of lectures per week	13:30-15:00	(Sundays and Tuesdays)
One (1) hour of tutorial per week	12:30-13:30	(Sundays)

5. OBJECTIVE AND SCOPE

The main objective of the course is to develop in the student a good understanding of the dam's structural behavior under seismic loading. The students are trained in this course to solve a number of real-life practical problems. The course will cover a broad range of structural engineering disciplines including Finite element analysis, Structural dynamics, Fluid mechanics, Fluid-structure interaction, Nonlinear behavior of concrete dams, Physical modeling. The course represents a state-of-the-art on seismic analysis of concrete dams.

The bases of the course are founded on the understanding of the principles, use of physical concepts and the application of a number of mathematical strategies to the case of dam-reservoir-foundation system. In principle, the course covers:

Fluid Mechanics, Dynamics of dam-reservoir-foundation system, solution of coupled systems, nonlinear dynamic analysis of concrete dams, retrofitting of concrete gravity dams, Small scale modeling, Hydroseismic Isolation and Alkali Aggregate Reaction (AAR).

6. RELATION OF THE COURSE TO PAST AND FUTURE STUDIES

Students are required to be familiar with the following subjects: Finite Element analysis Structural dynamics Fluid mechanics

7. TEXT

The material covered in the course (Analysis and Design of Concrete Dams) follows closely the treatment presented in the following course note (a copy will be provided to the students):

Concrete Dams, Seismic Analysis and Design By: Mohsen Ghaemian

8. VIDEO PRESENTATIONS

There would be two hours of video presentations as followings:Dam constructionOne hour (Recorded from TLC Channel)Flood control damsOne hour (Recorded from TLC Channel)

9. EVALUATION

There will be five- (5) set of assignments and one midterm examination and a final examination. The evaluation scheme is as follows:

	points
Five (5) set of assignments	40
Midterm exam	20
Final exam	40
Total	100
Assignments have different weights	and each is marked out of (100).

The exams will be of the closed book type and students are allowed one crib sheet and a calculator.

LIST OF ASSIGNMENTS

Numbering is the same as appears in the text book.

Month/day	Chapters	Sub Chapters	Problems
11/21	Introduction	Introduction	
11/28	Chapter 1	Stability Analysis of CG dams	Assignment 1
11/30		Definition of dam, types and purposes of	
		dams, Dams on Karoun River	
12/5		Hoover Dam (Movie Presentation)	
12/7		Karoun III Dam and Hydropower	
		Masjed Soleyman Dam and Hydropower	
		(Movie and Power point Presentation)	
12/12		Dam Safety	Assignment 2
		Iranian Approach To Dam Safety	
12/14		Instrumentation and Monitoring of	
		Concrete and Embankment Dams	
12/19	Chapter 2	Reservoir's Equation 2.1	Assignment 3
12/21		Reservoir's Equation 2.2	
12/26		Viscosity $2.3 \rightarrow 2.6$	
1/18		Irrotational flow $2.7 \rightarrow 2.8$	
1/20		Reservoir boundary conditiond 2.9	
1/25		Solution of the reservoir equation 2.10	
1/27		Reservoir truncated bc's 2.11	
2/1	Chapter 3	Finite Element modeling of the structure	Assignment 4
2/3		Finite element modeling of the reservoir	
2/8		Coupling or Decoupling of the equations	
2/10	Chapter 4	Movie Presentation	

		(Design of Karoun 3 arch dam)	
2/15		Coupled Equations	
2/17		Staggered method	
2/22		A-method+Energy balance error	
2/24	Chapter 5	Nonlinear analysis	Assignment 5
2/29		LEFM v.s. NLFM	
2/31		Smeared Crack Model	
3/5		Damage Mechanics	
3/7	Chapter 6	Temperature analysis and Boundary conditions	Assignment 6
3/12		Finite element modeling of temperature	
		Analysis	

COMPUTER CODES

NSAG-DRI A Computer Program for Nonlinear Seismic Analysis of Gravity dams Including Dam-Reservoir Interaction By: M. Ghaemian

EAGD-84 Earthquake Analysis of Concrete Gravity Dams By: Fenves and Chopra

EACD-3D Earthquake Analysis of Concrete Dams

By: Fenves and Chopra

FRAC_DAM A finite element analysis computer program to predict the FRACture and DAMage response of concrete structures By: S. Bhattacharjee

CADAM Computer Analysis of DAMs By: Martin Leclerc All the materials will be provided to the students by instructor. All the referenced papers in the text book will be available to the students.