Analysis and Design of Concrete Dams
1st Semester 1398-99

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1. **COURSE TITLE**
    Analysis and Design of Concrete Dams, 20-670

2. **INSTRUCTORS**
    - Lecturer: M. Ghaemian (**http://sharif.ir/~ghaemian/**)   **Room: 421** Ext. **4242**

3. **COURSE OUTLINE**
    Definition of dams, Types of dams, RCC dams, Stability of dams, Approximate design of concrete arch dams, Dam safety and Instrumentation, 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, Thermal studies of 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)

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.

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 and Fluid mechanics

7. **TEXT**
    The material covered in the course follows closely the treatment presented in:
    Method Statement and Design of Roller Compacted Concrete Gravity Dams; By Mohsen Ghaemian
    Concrete Dams, Seismic Analysis and Design; By Mohsen Ghaemian
    Some other materials will be provided to the students from different sources.

9. **EVALUATION**
    There will be seven- (7) set of assignments, one midterm and a final examinations.
    The evaluation scheme is as follows: Points
          Seven (7) set of assignments   25
          Midterm exam   20
          Final exam   55
          Total   100
    Assignments have different weights and each is marked out of (100). The exam will be of the closed book type and students are allowed one crib sheet and a calculator.

COMPUTER CODES

EAGD-84 Earthquake Analysis of Concrete Gravity 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.

LIST OF ASSIGNMENTS

Month/day	Chapters	Sub Chapters	Problems
6/31	Introduction	General	
7/2	**Chapter 1** **Stability Analysis of CG dams**	Definition of dam, types and purposes of dams, Dams on Karoun River	Assignment 1
7/7		Stability Analysis of CG dams 1	
7/9		Stability Analysis of CG dams 2	
7/14		Stability Analysis of CG dams 3 (dynamic time history)	
7/16	**Chapter 2** **Method Statement and Design of Roller Compacted Gravity Dams**	RCC Dams, Method Statement 1	Assignment 2
7/21		RCC Dams, Method Statement 2	
7/23		RCC Dams, Method Statement 3	
7/28		RCC Dams, Method Statement 4	
7/30		RCC Dams, Method Statement 5	
8/12	**Chapter 3** **Construction of Concrete Arch dams**	Hoover Dam (Movie Presentation)	
8/14		Karoun III Dam and Hydropower; (Movie Presentation; Design of Karoun 3 arch dam) Masjed Soleyman Dam and Hydropower; (Movie and Power point Presentation)	
8/19	**Chapter 4** **Dam Safety and Instrumentation**	Dam Safety Iranian Approach To Dam Safety	Assignment 3
8/21		Instrumentation of Concrete and Embankment Dams	
8/26		Monitoring of Concrete and Embankment Dams	
8/28	**Chapter 5** **Reservoir's Equation**	Reservoir's Equation 2.1	Assignment 4
9/3		Reservoir's Equation 2.2	
9/5		Viscosity 2.3→2.6 Irrotational flow 2.7→2.8	
9/10		Reservoir boundary conditiond 2.9 Solution of the reservoir equation 2.10	
9/12		Reservoir truncated bc's 2.11	
9/17	Midterm examination		
9/19	**Chapter 6** **Finite Element modeling of the Dam-Reservoir system**	Finite Element modeling of the structure	Assignment 5
9/24		Finite element modeling of the reservoir	
9/26			
10/1		Coupling or Decoupling of the equations	
10/3	**Chapter 7** **Solution of Dam-Reservoir equations**	Coupled Equations	Assignment 6
10/8		Staggered method	
10/10		α-Method+Energy Balance Error	
10/15	**Chapter 8** **Nonlinear Analysis**	Nonlinear Analysis, LEFM v.s. NLFM	Assignment 7
10/17		Smeared Crack Model, Damage Mechanics	