University of Tehran
School of Civil Engineering

Course:	**8102507 - Meshless Methods**		
Course type:	Optional		Credit: 3
Level:	PhD		
Co-requisite(s):	-		
Prerequisite(s):	-		
Prerequisite by topic:	-		
Textbook(s):	[1] Mesh Free Methods; G.R. Liu, CRC Press, 2003. [2] Smoothed Particle Hydrodynamics; G.R. Liu, M.B. Liu, World Scientific Press, 2003. [3] The Meshless Local Petrov-Galerkin (MLPG) Method; S.N. Atluri, S. Shen, Tech Science Press, 2004. [4] An Introduction to Meshless Methods and Their Programming; G.R.Liu, Y.T. Gu, Springer, 2005.		
Coordinator:	S. Mohammadi, Professor of Computational Mechanics, School of Civil Engineering		
Goals:	The main objective is to introduce the state of the art meshless methods as the most advanced numerical analysis techniques to the PhD and Msc students who are seeking advanced numerical techniques for studying highly complex engineering problems.		
Outcome:	1. A historical review of available techniques. 2. Approximation techniques a. Least square approximation techniques b. Point interpolation techniques c. Partition of unity methods d. Integral/kernel based approximations 3. Meshless partial differential equation solvers a. Weak form solutions b. Strong form solutions 4. Engineering applications		
Topics:	1. A historical review of available techniques. 2. Approximation techniques a. Weighted Least Square (WLS) approximation b. Moving Least Square (MLS) approximation c. Interpolating WLS and MLS d. Point Interpolation Method (PIM) e. Radial PIM (RPIM) f. Radial+Polynomial PIM (RPPIM) g. Partition of Unity methods (POU)		

	h. Smoothed Particle Hydrtodynamics (SPH) i. Corrected SPH and RKPM 3. Element Free Galerkin Method (EFG) a. Weak form solution with Lagrange Multiplier b. Background integration c. Weak form solution with penalty method d. Material discontinuity e. Crack Analysis, solution enrichment f. Elastodynamic problems g. Nonlinear problems h. Nodal integration and stabilization 5. Weak form solutions with PIM, RPIM and RPPIM 6. Meshless Local Petrov Galerkin Method (MLPG) 7. Smoothed Particle Hydrodynamics (SPH) 8. eXtended Finite Element Method (XFEM)
Computer usage:	Necessary for assignments and final project
Assignments:	15 homework assignments (programming and theoretical)
Projects:	1 final programming project
Grading:	Assignments: 35 % Project: 35 % Final exam: 30 %
Further readings:	[1] Several papers published on the subject every year.
Prepared by:	Soheil Mohammadi
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