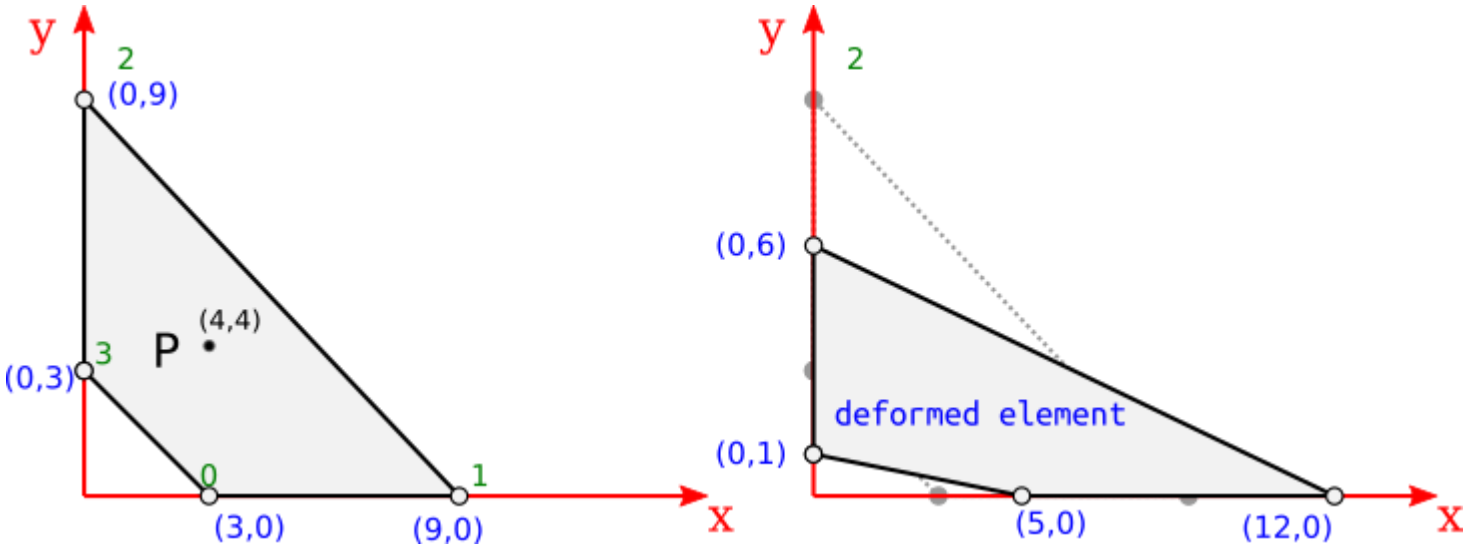
2021 Midterm Exam # 1 - Part 2

Start Assignment

Due Apr 29 by 6pm **Points** 0 **Submitting** a file upload **File Types** pdf



The bi-linear quadrilateral element (Quad4) shown is part of a larger finite-element mesh. The left image shows the undeformed configuration of the element, while the right side shows the final position, after deformation, of this element's node.

A. **(10 pts)** For the point P shown, how would you determine its natural rectangular coordinates (ξ, η)? Why was this easier to do in the case of the CST element. (Bonus 10 pts. do it!)

B. **(10 pts)** Consider another point Q with rectangular coordinates given by $\xi = 2\frac{D-1}{DM-1} - 1$ and $\eta = 2\frac{M-1}{11} - 1$ (where D is your birth day, DM is the number of days in your birth month, M is your birth month (January = 1, February = 2, etc.). Give your birthdate and the resulting coordinates. For that point compute its global coordinates.

C. **(20 pts)** Compute all derivatives of Quad4 shape-functions at your point Q with respect to global coordinates.

D. **(15 pts)** Compute the components of the strain tensor for point Q after the element has experienced the shown deformation. Show your work.

E. **(5 pts)**Explain what Iso-Parameteric finite-elements are and why they are attractive.

Some Rubric (1)

Criteria	Ratings					Pts
A. Natural coordinates for P.	**10 pts** **Full Marks**		**5 pts** **5**		**0 pts** **No Marks**	10 pts
B. Global coordinates for Q	**10 pts** **Full Marks**		**5 pts** **5**		**0 pts** **No Marks**	10 pts
C. Derivatives of shape fcns at Q.	**20 pts** **Full Marks**	**15 pts** **15**	**10 pts** **10**	**5 pts** **5**	**0 pts** **No Marks**	20 pts
D. Strain at Q	**15 pts** **Full Marks**	**12 pts** **12**	**8 pts** **8**	**4 pts** **4**	**0 pts** **No Marks**	15 pts
E. What is Iso-P	**5 pts** **Full Marks**		**3 pts** **3**		**0 pts** **No Marks**	5 pts
						Total Points: 60