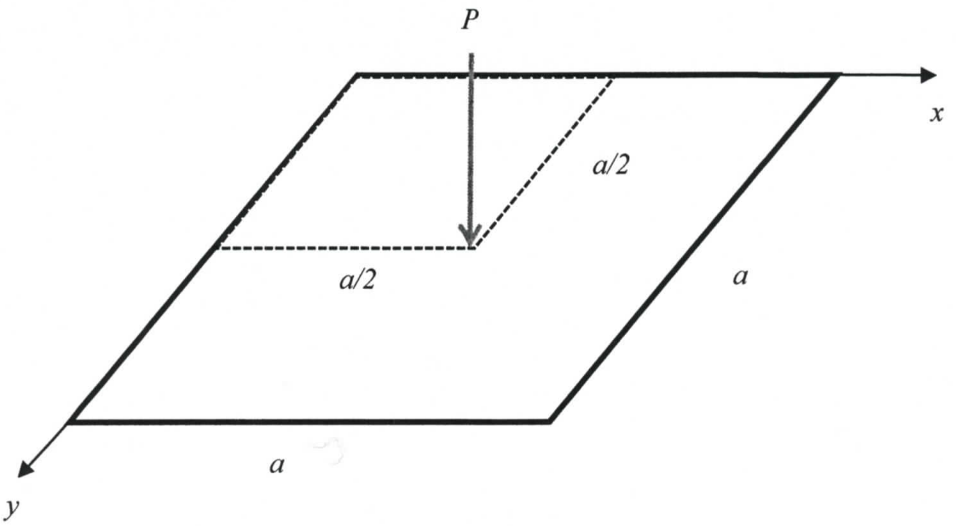
Closed book examination, only writing instruments are allowed. Write your name, study program and the course code on each answering sheet. This exam (2 pages) includes 3 questions (each 8 scores) for 24 scores of the first partial exam. Some of the required formulas are given.

Duration: 2 hours

1. A thin rectangular ($a \times b$) plate is simply supported on all edges and is subjected to the loading $p_z(x,y) = P \sin\frac{2\pi x}{a} \sin\frac{3\pi y}{b}$. Determine the deflection of the plate.

2. A thin circular plate with radius R and flexural rigidity D, is taken to be clamped at the edge and is subjected to rotationally symmetric loading $p_z = \frac{p_0 r^2}{R}$ (r is the variable in the polar coordinate system). Determine the deflection of the plate.

3- Consider a thin clamped square plate ($a \times a$) subjected to a concentrated lateral force P at the center of the plate ($a/2 \times a/2$). The material properties are (E,ν) while the thickness of the plate is h. Determine the deflection of this plate by the Ritz method using one term as the shape function.



Formulas:

Governing equation for the static analysis of classical plate:

$$\nabla^2\nabla^2 w = \frac{p_z}{D}, \quad D = \frac{Eh^3}{12(1-\nu^2)}$$

Governing equation for the static analysis of axisymmetric circular classical plate in polar coordinates:

$$\nabla^4 w(r) = \frac{p_z(r)}{D}, \quad while \quad \nabla^4 w = \nabla^2\nabla^2 w = \frac{1}{r}\frac{d}{dr}\left\{r\frac{d}{dr}\left[\frac{1}{r}\frac{d}{dr}\left(r\frac{dw}{dr}\right)\right]\right\}$$

In the Kirchhof–Love model, the potential energy (Π) of a rectangular plate:

$$\Pi = \frac{D}{2}\int_0^b\int_0^a\left\{\left(\nabla^2 w\right)^2 - 2(1-\nu)\left[\frac{\partial^2 w}{\partial x^2}\frac{\partial^2 w}{\partial y^2} - \left(\frac{\partial^2 w}{\partial x\partial y}\right)^2\right]\right\}dxdy - \int_0^b\int_0^a p_z w dxdy$$

In case of clamped plate, you can use the simplified form of potential energy.