Indian Institute of Science
ME 242: Midsemester Test

Date: 2/11/13.
Duration: 2.30 p.m.–3.30 p.m.
Maximum Marks: 10

1. A semi-infinite wedge is subjected to a point load $P\boldsymbol{e}_y$ as shown in Fig. 1. Assume the Airy stress function to be of the form

$$\phi = J_2 r\theta \sin\theta + H_2 r\theta \cos\theta.$$

Verify *except* at $r = 0$ if the traction boundary conditions are satisfied. Next by considering an appropriate free body diagram, find the constants J_2 and H_2. The relevant formulae for plane stress conditions are

$$\begin{aligned}
2Eu_r &= \left[2(1-\nu)\theta\sin\theta + (1-\nu+4\log r)\cos\theta\right] J_2 \\
&\quad + \left[2(1-\nu)\theta\cos\theta - (1-\nu+4\log r)\sin\theta\right] H_2, \\
2Eu_\theta &= \left[2(1-\nu)\theta\cos\theta - (3+\nu+4\log r)\sin\theta\right] J_2 \\
&\quad - \left[2(1-\nu)\theta\sin\theta + (3+\nu+4\log r)\cos\theta\right] H_2, \\
\tau_{rr} &= \frac{1}{r}\frac{\partial\phi}{\partial r} + \frac{1}{r^2}\frac{\partial^2\phi}{\partial\theta^2}, & \tau_{\theta\theta} &= \frac{\partial^2\phi}{\partial r^2}, \\
\tau_{r\theta} &= -\frac{\partial}{\partial r}\left(\frac{1}{r}\frac{\partial\phi}{\partial\theta}\right), \\
\cos 2\theta &= \cos^2\theta - \sin^2\theta, & \sin 2\theta &= 2\sin\theta\cos\theta.
\end{aligned}$$

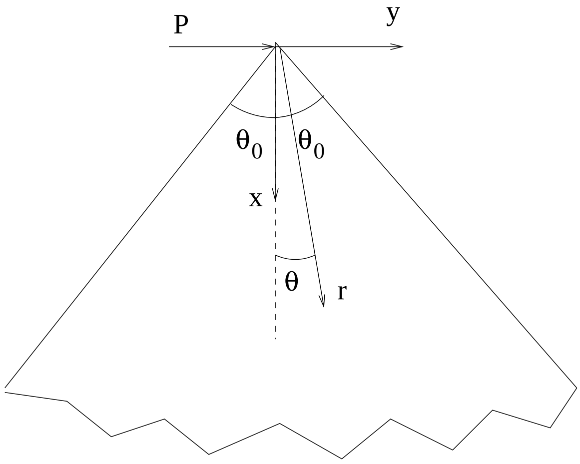

Figure 1: Semi-infinite wedge subjected to a point load P along the y-direction.