

Problem Set 4

(4.1) Selection rules. Obtain the explicit form of $\mathcal{A}(l, m, l', m', q)$ (introduced in the lecture, (see 1.143)) by using the recurrence relations for the associated Legendre polynomials

$$(2l + 1) \cos \theta P_l^m(\cos \theta) = (l + 1 - m) P_{l+1}^m(\cos \theta) + (l + m) P_{l-1}^m(\cos \theta)$$

and

$$(2l + 1) \sin \theta P_l^{m-1}(\cos \theta) = P_{l+1}^m(\cos \theta) - P_{l-1}^m(\cos \theta),$$

and

$$Y_l^m(\theta, \phi) = (-1)^m \left[\frac{(2l + 1)(l - m)!}{4\pi(l + m)!} \right]^{1/2} P_l^m(\cos \theta) e^{im\phi}, m \geq 0.$$

(4.2) Nozzle flow. Derive the equations (1) and (2) from the “The analysis of compressible fluid flow” (see lecture of Prof. Dr. Karl-Heinz Meiwes-Broer (20.10.2011))

Hint: Use the energy balance for the steady flow system.