

## Homework 3

### Geometrical methods in theoretical physics HT-14

1. Consider the connection  $D$  on the vector bundle  $E$  over  $M$  (see the axiomatic definition from Lectures or Nakahara). Choosing the local basis of sections  $e^\alpha$  we can define the connection as

$$D_v e^\alpha = \Gamma_{\mu\beta}^\alpha v^\mu e^\beta, \quad v \in \Gamma(TM).$$

The basis is changed as  $\tilde{e}^\alpha = t^\alpha_\beta(x) e^\beta$  and the section of the vector bundle is  $s = s_\alpha(x) e^\alpha$ . Work out the rules  $D_v s$  and the transformation rules for  $\Gamma$ . If we define another connection  $\tilde{\Gamma}$  on  $E$ , then what are the properties of  $\Gamma - \tilde{\Gamma}$ .

2. Using above result, derive the explicit expression for the curvature in terms of  $\Gamma$ .

**to be handed in before 5 p.m., January 15, 2015**