Kovariantní vnější der. na vekt. bundle

$\Lambda^p_{\otimes} A^{\mathfrak{q}}_{\ell} M$

$\phi_1 \wedge \phi_2 \wedge \ldots = \binom{p}{p_1\, p_2 \ldots} \mathcal{A}(\phi_1 \otimes \phi_2 \otimes \ldots)$

$p_1\, {}^{\mathfrak{q}_1}_{\ell_1} \quad p_2\, {}^{\mathfrak{q}_2}_{\ell_2}$

$\phi^{M}_{\underline{m}} \wedge \psi^{N}_{\underline{n}} = 2\, \phi^{M}_{[\underline{m}} \psi^{N}_{\underline{n}]}$

$= \phi^{M}_{\underline{m}} \otimes \psi^{N}_{\underline{n}} - \phi^{M}_{\underline{n}} \otimes \psi^{N}_{\underline{m}}$

${}^{D}d$ kov. vnější der na $\Lambda^p A^{\mathfrak{q}}_{\ell} M$ $\qquad ({}^{D}d\phi)_{a_0 a_1 \ldots a_p} = (p+1)\, D_{[a_0} \phi_{a_1 \ldots a_p]}$

${}^{D}d : \mathrm{Sect}\, \Lambda^p A^{\mathfrak{q}}_{\ell} M \to \Lambda^{p+1} A^{\mathfrak{q}}_{\ell} M$

${}^{D}d(\phi + \psi) = {}^{D}d\phi + {}^{D}d\psi$

${}^{D}d(\phi \wedge \psi) = ({}^{D}d\phi) \wedge \psi + (-1)^{p}\, \phi \wedge {}^{D}d\psi$

${}^{D}d\phi = D\phi$ pro $\phi \in \mathrm{Sect}\, A^{\mathfrak{q}}_{\ell} M$ $\quad p=0$

${}^{D}d\phi = d\phi$ pro $\phi \in \mathrm{Sect}\, \Lambda^p M$ $\quad \mathfrak{q}, \ell = 0$

$$\phi = \sum_{a_1 < \ldots < a_p} \phi_{a_1 \ldots a_p}\, dx^{a_1} \wedge \ldots \wedge dx^{a_p} \qquad \phi_{a_1 \ldots a_p} \in \mathrm{Sect}\, A^{\mathfrak{q}}_{\ell} M$$

$${}^{D}d\phi = \sum_{a_1 < \ldots < a_p} {}^{D}d\phi_{a_1 \ldots a_p} \wedge dx^{a_1} \wedge \ldots \wedge dx^{a_p} = (p+1) \sum_{a_0 < a_1 < \ldots < a_p} D_{[a_0} \phi_{a_1 \ldots a_p]}\, dx^{a_0} \wedge dx^{a_1} \wedge \ldots \wedge dx^{a_p}$$

Kovariantní vnější der. na vekt. bundle

$$\Lambda^{p}_{\otimes} \mathcal{A}^{q}_{l} M$$

$$\phi_1 \wedge \phi_2 \wedge \dots = \binom{p}{p_1\; p_2 \dots} \mathcal{A}(\phi_1 \otimes \phi_2 \otimes \dots)$$

$p_1{}^{q_1}_{l_1} \quad p_2{}^{q_2}_{l_2}$

$$\phi^{\underline{M}}_{\underline{m}} \wedge \psi^{\underline{N}}_{\underline{n}} = 2\, \phi^{\underline{M}}_{[\underline{m}} \psi^{\underline{N}}_{\underline{n}]}$$

$$= \phi^{\underline{M}}_{\underline{m}} \otimes \psi^{\underline{N}}_{\underline{n}} - \phi^{\underline{M}}_{\underline{n}} \otimes \psi^{\underline{N}}_{\underline{m}}$$

${}^D d$ kov. vnější der. na $\Lambda^p A^q_l M$

$${}^D d : \operatorname{Sect} \Lambda^p A^q_l M \to \Lambda^{p+1} A^q_l M$$

$${}^D d(\phi + \psi) = {}^D d\phi + {}^D d\psi$$

$${}^D d(\phi \wedge \psi) = ({}^D d\phi) \wedge \psi + (-1)^p \phi \wedge {}^D d\psi$$

$${}^D d \overset{1_p}{\phi} = D\phi \quad \text{pro } \phi \in \operatorname{Sect} A^q_l M \quad p = 0$$

$${}^D d\phi = d\phi \quad \text{pro } \phi \in \operatorname{Sect} \Lambda^p M \quad q, l = 0$$

${}^{D}d$ kov. vnější der. na $\Lambda^p A^{k}_{l} M$ $\quad ({}^{D}d\phi)_{a_0 a_1 \dots a_p} = (p+1)\, D_{[a_0} \phi_{a_1 \dots a_p]}$

$${}^{D}d : \mathcal{S}ect\, \Lambda^p A^{k}_{l} M \to \Lambda^{p+1} A^{k}_{l} M$$

$${}^{D}d(\phi + \psi) = {}^{D}d\phi + {}^{D}d\psi$$

$${}^{D}d(\underset{p}{\phi} \wedge \psi) = ({}^{D}d\phi) \wedge \psi + (-1)^p \phi \wedge {}^{D}d\psi$$

${}^{D}d\phi = D\phi$ pro $\phi \in \mathcal{S}ect\, A^{k}_{l} M$ $\quad p=0$

${}^{D}d\phi = d\phi$ pro $\phi \in \mathcal{S}ect\, \Lambda^p M$ $\quad k, l=0$

$$\phi = \sum_{a_1 < \dots < a_p} \phi_{a_1 \dots a_p}\, dx^{a_1} \wedge \dots \wedge dx^{a_p} \qquad \phi_{a_1 \dots a_p} \in \mathcal{S}ect\, A^{k}_{l} M$$

$${}^{D}d\phi = \sum_{a_1 < \dots < a_p} {}^{D}d\phi_{a_1 \dots a_p} \wedge dx^{a_1} \wedge \dots \wedge dx^{a_p} = (p+1) \sum_{a_0 < a_1 < \dots < a_p} D_{[a_0} \phi_{a_1 \dots a_p]}\, dx^{a_0} \wedge dx^{a_1} \wedge \dots \wedge dx^{a_p}$$

D na AM

∇ na TM $\quad T^{\underline{a}}_{\underline{mn}}$

D rozšíření D na TM

$$D(\underset{\substack{\uparrow \\ TM}}{A} \otimes \underset{\substack{\uparrow \\ AM}}{\phi}) = \underbrace{(DA)}_{\nabla A} \otimes \phi + A \otimes \underbrace{(D\phi)}_{D\phi}$$

$$\overset{D}{d}_{a_0} \phi^{\underline{A}}_{a_1 \dots a_p} = D_{a_0} \wedge \phi^{\underline{A}}_{a_1 \dots a_p} + T^{n}_{a_0 a_1} \wedge \phi^{\underline{A}}_{|n| a_2 \dots a_p}$$

$$= (p+1) D_{[a_0} \phi^{\underline{A}}_{a_1 \dots a_p]} + \binom{p+1}{2} T^{n}_{[a_0 a_1} \phi_{|n| a_2 \dots a_p]}$$

$\overset{D}{d}$ kov. vnější der. na $\Lambda^p A^k_l M$ $\qquad (\overset{D}{d}\phi)_{a_0 a_1 \dots a_p} = (p+1) D_{[a_0} \phi_{a_1 \dots a_p]}$

$$\overset{D}{d} : \operatorname{Sect} \Lambda^p A^k_l M \to \Lambda^{p+1} A^k_l M$$

$$\overset{D}{d}(\phi + \psi) = \overset{D}{d}\phi + \overset{D}{d}\psi$$

$$\overset{D}{d}(\underset{p}{\phi} \wedge \psi) = (\overset{D}{d}\phi) \wedge \psi + (-1)^p \phi \wedge \overset{D}{d}\psi$$

$\overset{D}{d}\phi = D\phi$ pro $\phi \in \operatorname{Sect} A^k_l M$ $\quad p=0$

$\overset{D}{d}\phi = d\phi$ pro $\phi \in \operatorname{Sect} \Lambda^p M$ $\quad k,l=0$

$$\phi = \sum_{a_1 < \dots < a_p} \phi_{a_1 \dots a_p} dx^{a_1} \wedge \dots \wedge dx^{a_p} \qquad \phi_{a_1 \dots a_p} \in \operatorname{Sect} A^k_l M$$

$$\overset{D}{d}\phi = \sum_{a_1 < \dots < a_p} \overset{D}{d}\phi_{a_1 \dots a_p} \wedge dx^{a_1} \wedge \dots \wedge dx^{a_p} = (p+1) \sum_{a_0 < a_1 < \dots < a_p} D_{[a_0} \phi_{a_1 \dots a_p]} dx^{a_0} \wedge dx^{a_1} \wedge \dots \wedge dx^{a_p}$$

D na $\mathbb{A}M$

∇ na $\mathbb{T}M$ $\qquad T^{\underline{a}}_{\underline{mn}}$

D rozšíření D na $\mathbb{T}M$

$$\mathrm{D}(\underset{\substack{\uparrow \\ \mathbb{T}M}}{A} \otimes \underset{\substack{\uparrow \\ \mathbb{A}M}}{\phi}) = \underbrace{(\mathrm{D}A)}_{\nabla A} \otimes \phi + A \otimes \underbrace{(\mathrm{D}\phi)}_{\mathrm{D}\phi}$$

$${}^{\mathrm{D}}\mathrm{d}_{\underline{a}_0} \phi^{\underline{A}}_{\underline{a}_1 \dots \underline{a}_p} = \mathrm{D}_{\underline{a}_0} \wedge \phi^{\underline{A}}_{\underline{a}_1 \dots \underline{a}_p} + T^{\underline{n}}_{\underline{a}_0 \underline{a}_1} \wedge \phi^{\underline{A}}_{|\underline{n}| \underline{a}_2 \dots \underline{a}_p}$$

$$= (p+1)\, \mathrm{D}_{[\underline{a}_0} \phi^{\underline{A}}_{\underline{a}_1 \dots \underline{a}_p]} + \binom{p+1}{2} T^{\underline{n}}_{[\underline{a}_0 \underline{a}_1} \phi^{\underline{A}}_{|\underline{n}| \underline{a}_2 \dots \underline{a}_p]}$$