$$\boldsymbol{A} = A + A^{x} e_{x} + A^{y} e_{y} + A^{z} e_{z} + A^{xy} e_{x}\wedge e_{y} + A^{xz} e_{x}\wedge e_{z} + A^{yz} e_{y}\wedge e_{z} + A^{xyz} e_{x}\wedge e_{y}\wedge e_{z}$$

$$\begin{aligned}\boldsymbol{A} =& A \\ & + A^{x} e_{x} + A^{y} e_{y} + A^{z} e_{z} \\ & + A^{xy} e_{x}\wedge e_{y} + A^{xz} e_{x}\wedge e_{z} + A^{yz} e_{y}\wedge e_{z} \\ & + A^{xyz} e_{x}\wedge e_{y}\wedge e_{z}\end{aligned}$$

$$\begin{aligned}\boldsymbol{A} =& A \\ & + A^{x} e_{x} \\ & + A^{y} e_{y} \\ & + A^{z} e_{z} \\ & + A^{xy} e_{x}\wedge e_{y} \\ & + A^{xz} e_{x}\wedge e_{z} \\ & + A^{yz} e_{y}\wedge e_{z} \\ & + A^{xyz} e_{x}\wedge e_{y}\wedge e_{z}\end{aligned}$$

$$\boldsymbol{A} = A^{x} e_{x} + A^{y} e_{y} + A^{z} e_{z}$$

$$\boldsymbol{B} = B^{xy} e_{x}\wedge e_{y} + B^{xz} e_{x}\wedge e_{z} + B^{yz} e_{y}\wedge e_{z}$$

$$\boldsymbol{\nabla} f = \partial_{x} f e_{x} + \partial_{y} f e_{y} + \partial_{z} f e_{z}$$

$$\boldsymbol{\nabla}\cdot\boldsymbol{A} = \partial_{x} A^{x} + \partial_{y} A^{y} + \partial_{z} A^{z}$$

$$\boldsymbol{\nabla}\boldsymbol{A} = \left (\partial_{x} A^{x} + \partial_{y} A^{y} + \partial_{z} A^{z}\right) + \left (- \partial_{y} A^{x} + \partial_{x} A^{y}\right) e_{x}\wedge e_{y} + \left (- \partial_{z} A^{x} + \partial_{x} A^{z}\right) e_{x}\wedge e_{z} + \left (- \partial_{z} A^{y} + \partial_{y} A^{z}\right) e_{y}\wedge e_{z}$$

$$-I(\boldsymbol{\nabla}\wedge\boldsymbol{A}) = \left (- \partial_{z} A^{y} + \partial_{y} A^{z}\right) e_{x} + \left (\partial_{z} A^{x} - \partial_{x} A^{z}\right) e_{y} + \left (- \partial_{y} A^{x} + \partial_{x} A^{y}\right) e_{z}$$

$$\boldsymbol{\nabla}\boldsymbol{B} = \left (- \partial_{y} B^{xy} - \partial_{z} B^{xz}\right) e_{x} + \left (\partial_{x} B^{xy} - \partial_{z} B^{yz}\right) e_{y} + \left (\partial_{x} B^{xz} + \partial_{y} B^{yz}\right) e_{z} + \left (\partial_{z} B^{xy} - \partial_{y} B^{xz} + \partial_{x} B^{yz}\right) e_{x}\wedge e_{y}\wedge e_{z}$$

$$\boldsymbol{\nabla}\wedge\boldsymbol{B} = \left (\partial_{z} B^{xy} - \partial_{y} B^{xz} + \partial_{x} B^{yz}\right) e_{x}\wedge e_{y}\wedge e_{z}$$

$$\boldsymbol{\nabla}\cdot\boldsymbol{B} = \left (- \partial_{y} B^{xy} - \partial_{z} B^{xz}\right) e_{x} + \left (\partial_{x} B^{xy} - \partial_{z} B^{yz}\right) e_{y} + \left (\partial_{x} B^{xz} + \partial_{y} B^{yz}\right) e_{z}$$

$$g_{ij} = \left[\begin{array}{cccc}\left (a\cdot a\right) & \left (a\cdot b\right) & \left (a\cdot c\right) & \left (a\cdot d\right) \\ \left (a\cdot b\right) & \left (b\cdot b\right) & \left (b\cdot c\right) & \left (b\cdot d\right) \\ \left (a\cdot c\right) & \left (b\cdot c\right) & \left (c\cdot c\right) & \left (c\cdot d\right) \\ \left (a\cdot d\right) & \left (b\cdot d\right) & \left (c\cdot d\right) & \left (d\cdot d\right)\end{array}\right]$$

$$\boldsymbol{a\cdot (bc)} = - \left (a\cdot c\right) b + \left (a\cdot b\right) c$$

$$\boldsymbol{a\cdot (b\wedge c)} = - \left (a\cdot c\right) b + \left (a\cdot b\right) c$$

$$\boldsymbol{a\cdot (b\wedge c\wedge d)} = \left (a\cdot d\right) b\wedge c - \left (a\cdot c\right) b\wedge d + \left (a\cdot b\right) c\wedge d$$

$$\boldsymbol{a\cdot (b\wedge c)+c\cdot (a\wedge b)+b\cdot (c\wedge a)} = 0$$

$$\boldsymbol{a(b\wedge c)-b(a\wedge c)+c(a\wedge b)} = 3a\wedge b\wedge c$$

$$\boldsymbol{a(b\wedge c\wedge d)-b(a\wedge c\wedge d)+c(a\wedge b\wedge d)-d(a\wedge b\wedge c)} = 4a\wedge b\wedge c\wedge d$$

$$\boldsymbol{(a\wedge b)\cdot (c\wedge d)} = - \left (a\cdot c\right) \left (b\cdot d\right) + \left (a\cdot d\right) \left (b\cdot c\right)$$

$$\boldsymbol{((a\wedge b)\cdot c)\cdot d} = - \left (a\cdot c\right) \left (b\cdot d\right) + \left (a\cdot d\right) \left (b\cdot c\right)$$

$$\boldsymbol{(a\wedge b)\times (c\wedge d)} = - \left (b\cdot d\right) a\wedge c + \left (b\cdot c\right) a\wedge d + \left (a\cdot d\right) b\wedge c - \left (a\cdot c\right) b\wedge d$$

$$E = e_{1}\wedge e_{2}\wedge e_{3}$$

$$E^{2} = \left (e_{1}\cdot e_{2}\right)^{2} - 2 \left (e_{1}\cdot e_{2}\right) \left (e_{1}\cdot e_{3}\right) \left (e_{2}\cdot e_{3}\right) + \left (e_{1}\cdot e_{3}\right)^{2} + \left (e_{2}\cdot e_{3}\right)^{2} - 1$$

$$E1 = (e2\wedge e3)E = \left (\left (e_{2}\cdot e_{3}\right)^{2} - 1\right) e_{1} + \left (\left (e_{1}\cdot e_{2}\right) - \left (e_{1}\cdot e_{3}\right) \left (e_{2}\cdot e_{3}\right)\right) e_{2} + \left (- \left (e_{1}\cdot e_{2}\right) \left (e_{2}\cdot e_{3}\right) + \left (e_{1}\cdot e_{3}\right)\right) e_{3}$$

$$E2 = -(e1\wedge e3)E = \left (\left (e_{1}\cdot e_{2}\right) - \left (e_{1}\cdot e_{3}\right) \left (e_{2}\cdot e_{3}\right)\right) e_{1} + \left (\left (e_{1}\cdot e_{3}\right)^{2} - 1\right) e_{2} + \left (- \left (e_{1}\cdot e_{2}\right) \left (e_{1}\cdot e_{3}\right) + \left (e_{2}\cdot e_{3}\right)\right) e_{3}$$

$$E3 = (e1\wedge e2)E = \left (- \left (e_{1}\cdot e_{2}\right) \left (e_{2}\cdot e_{3}\right) + \left (e_{1}\cdot e_{3}\right)\right) e_{1} + \left (- \left (e_{1}\cdot e_{2}\right) \left (e_{1}\cdot e_{3}\right) + \left (e_{2}\cdot e_{3}\right)\right) e_{2} + \left (\left (e_{1}\cdot e_{2}\right)^{2} - 1\right) e_{3}$$

$$E1 \cdot e2 = 0$$
$$E1 \cdot e3 = 0$$
$$E2 \cdot e1 = 0$$
$$E2 \cdot e3 = 0$$
$$E3 \cdot e1 = 0$$
$$E3 \cdot e2 = 0$$
$$(E1 \cdot e1)/E^{2} = 1$$
$$(E2 \cdot e2)/E^{2} = 1$$
$$(E3 \cdot e3)/E^{2} = 1$$
$$A = A^{r} e_{r} + A^{\theta} e_{\theta} + A^{\phi} e_{\phi}$$
$$B = B^{r\theta} e_{r} \wedge e_{\theta} + B^{r\phi} e_{r} \wedge e_{\phi} + B^{\phi\phi} e_{\theta} \wedge e_{\phi}$$
$$\boldsymbol{\nabla} f = \partial_{r} f e_{r} + \partial_{\theta} f e_{\theta} + \partial_{\phi} f e_{\phi}$$
$$\boldsymbol{\nabla} \cdot A = \partial_{\phi} A^{\phi} + \partial_{r} A^{r} + \partial_{\theta} A^{\theta}$$
$$-I(\boldsymbol{\nabla} \wedge A) = \left(\partial_{\theta} A^{\phi} - \partial_{\phi} A^{\theta}\right) e_{r} + \left(-\partial_{r} A^{\phi} + \partial_{\phi} A^{r}\right) e_{\theta} + \left(-\partial_{\theta} A^{r} + \partial_{r} A^{\theta}\right) e_{\phi}$$
$$\boldsymbol{\nabla} \wedge B = \left(-\partial_{\theta} B^{r\phi} + \partial_{\phi} B^{r\theta} + \partial_{r} B^{\phi\phi}\right) e_{r} \wedge e_{\theta} \wedge e_{\phi}$$
$$B = \boldsymbol{B\gamma_{t}} = -B^{x} \gamma_{t} \wedge \gamma_{x} - B^{y} \gamma_{t} \wedge \gamma_{y} - B^{z} \gamma_{t} \wedge \gamma_{z}$$
$$E = \boldsymbol{E\gamma_{t}} = -E^{x} \gamma_{t} \wedge \gamma_{x} - E^{y} \gamma_{t} \wedge \gamma_{y} - E^{z} \gamma_{t} \wedge \gamma_{z}$$
$$F = E + IB = -E^{x} \gamma_{t} \wedge \gamma_{x} - E^{y} \gamma_{t} \wedge \gamma_{y} - E^{z} \gamma_{t} \wedge \gamma_{z} - B^{z} \gamma_{x} \wedge \gamma_{y} + B^{y} \gamma_{x} \wedge \gamma_{z} - B^{x} \gamma_{y} \wedge \gamma_{z}$$
$$J = J^{t} \gamma_{t} + J^{x} \gamma_{x} + J^{y} \gamma_{y} + J^{z} \gamma_{z}$$
$$\boldsymbol{\nabla} F = J$$
$$R = \cosh\left(\frac{\alpha}{2}\right) + \sinh\left(\frac{\alpha}{2}\right) \gamma_{t} \wedge \gamma_{x}$$
$$t\boldsymbol{\gamma_{t}} + x\boldsymbol{\gamma_{x}} = t'\boldsymbol{\gamma'_{t}} + x'\boldsymbol{\gamma'_{x}} = R\left(t'\boldsymbol{\gamma_{t}} + x'\boldsymbol{\gamma_{x}}\right) R^{\dagger}$$
$$t\boldsymbol{\gamma_{t}} + x\boldsymbol{\gamma_{x}} = \left(2t' \sinh^{2}\left(\frac{\alpha}{2}\right) + t' - x' \sinh\left(\alpha\right)\right) \gamma_{t} + \left(-t' \sinh\left(\alpha\right) + 2x' \sinh^{2}\left(\frac{\alpha}{2}\right) + x'\right) \gamma_{x}$$
$$\sinh\left(\alpha\right) = \gamma\beta$$
$$\cosh\left(\alpha\right) = \gamma$$
$$t\boldsymbol{\gamma_{t}} + x\boldsymbol{\gamma_{x}} = \left(-\beta\gamma x' + 2t' \sinh^{2}\left(\frac{\alpha}{2}\right) + t'\right) \gamma_{t} + \left(-\beta\gamma t' + 2x' \sinh^{2}\left(\frac{\alpha}{2}\right) + x'\right) \gamma_{x}$$
$$\boldsymbol{A} = A^{t} \gamma_{t} + A^{x} \gamma_{x} + A^{y} \gamma_{y} + A^{z} \gamma_{z}$$
$$\boldsymbol{\psi} = \psi + \psi^{tx} \gamma_{t} \wedge \gamma_{x} + \psi^{ty} \gamma_{t} \wedge \gamma_{y} + \psi^{tz} \gamma_{t} \wedge \gamma_{z} + \psi^{xy} \gamma_{x} \wedge \gamma_{y} + \psi^{xz} \gamma_{x} \wedge \gamma_{z} + \psi^{yz} \gamma_{y} \wedge \gamma_{z} + \psi^{txyz} \gamma_{t} \wedge \gamma_{x} \wedge \gamma_{y} \wedge \gamma_{z}$$