In this thesis, we investigate the magnetic properties of an antiferromagnet Mn_5Si_3. Mn_5Si_3 shows two configurations of magnetic moments depending on temperature: the low-temperature phase (below 90 K) is noncollinear and noncoplanar, while the spin configuration is collinear at higher temperatures up to 240 K. Furthermore, the band structure of Mn_5Si_3 is spin-split in both antiferromagnetic phases via a specific nonrelativistic mechanism, referred as altermagnetism. We probed this spin-splitting by two distinct methods: Firstly, we characterized the transport properties of Mn_5Si_3 by measuring electronic and thermoelectric transport phenomena. Particularly, we detected the spontaneous Hall and Nernst responses in Mn_5Si_3 thin epitaxial films. The key outcome was a detailed analysis of the spontaneous Hall signal together with the observation of the spontaneous Nernst effect. In the second approach, we studied magnetooptical response of the thin films, where we focused on reflective geometry (the polar Kerr effect and the Voigt effect). We observed a pronounced signal in the Voigt geometry, which is quadratic in magnetization and could correspond to a magnetooptical signal. Furthermore, we observed a change in optical response when the thin-film samples were exposed to a thermally-induced mechanical strain. The results indicate that Mn_5Si_3 shows an altermagnetic phase which can be analyzed using electronic and thermoelectric transport. Magnetooptical methods revealed some potential, however, further experiments are needed to confirm the origin of the observed optical signals.