This is a review text file submitted electronically to MR.

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Author: This line will be completed by the MR staff.

Short title: This line will be completed by the MR staff.

MR Number: 2100341

Primary classification: 81Q60

Secondary classification(s): 17B81

Review text:

In textbooks on quantum mechanics, one of the most popular algebraic interpretations of the equidistance of the spectrum of the harmonic oscillator is often presented as a consequence of the factorization of its Hamiltonian $H = p^2 + q^2$ into a product of the so called annihilation and creation (or "ladder") linear differential operators L^- and L^+ of the first order, respectively. The corresponding Lie algebra generated by H, L^- and L^+ is usually called oscillator or Heisenberg algebra. Its mth-order polynomial generalizations may be then built from the $(m+1)$th-order linear differential operators L^- and L^+, the commutator of which happens to be just an mth-order polynomial in H. Such a construction has been known related to the so called supersymmetric partners of the harmonic oscillators at even m. In the paper it is shown that the same observation applies also at the odd m. In addition, the authors show that and how the Painlevé transcendents of types IV and V emerge in connection with similar algebras (called "deformed Lie algebras") at $m = 2$ and $m = 3$, respectively.