Hysteresis Machines. N. D. Sharma and R. E. Bedford. Perfect Prints, 22/23, Jyoti Industrial Estate, Nooribaba Darga Road, Near Makhamali Talao, Thane (W) 400 601, India. 2003. 262 pp. Price not mentioned.

Hysteresis machines are not generally known. Even textbooks in electrical machines seldom devote more than a page to these noiseless, self-starting synchronous machines, widely used in clocks, record players, tape recorders, videotapes that are of daily use. Special types of hysteresis motors of larger ratings are increasingly finding application in specialized fields such as positioning of control rods in nuclear reactors, synchronized textile drives, etc.

An authentic book or hysteresis machines written by Sharma with his extensive knowledge of design, fabrication and testing of these machines and by Bedford with his profound understanding of the physics of electrical machines is a valuable addition to the literature on electrical machines.

Hysteresis machines are essentially induction machines, where the rotor core is made of magnetically hard material. In contrast to permanent magnet synchronous machines whose rotor is pre-magnetized prior to assembly, the rotor of hysteresis machines is magnetized by the rotating field of the armature winding at starting. In a normal induction machine, a rotating magnetic field is produced by the armature of stator winding. It rotates at synchronous speed and induces a voltage in the rotor circuit because of the relative motion between the rotating field and the rotor conductors. Rotor currents at slip frequency (slip is defined as $S = (n_s - n_r)/n_s$, where n_s is synchronous speed determined by supply frequency and number of poles and n_r is rotor speed) produce a magnetic field rotating at synchronous speed and therefore stationary with respect to the armature field. If the rotor were to reach synchronous speed, slip is zero and there is no relative motion between the armature magnetic field and the rotor conductors. Hence there is no induced voltage and no currents can flow in the rotor circuit. The rotor magnetic field ceases to exist and no torque is produced (or torque is zero at zero slip) until the rotor slows down just enough so that electrical torque can meet the load torque.

In the case of hysteresis motors, the residual magnetism is large and enables the rotor to lock onto synchronous speed, still producing electrical torque and the hysteresis motor behaves like a permanent magnet synchronous machine. Ideally, the torque of the hysteresis motor remains constant from starting to synchronous speed. So a hysteresis motor self-starts (provided the load torque is less than the electrical torque) and accelerates smoothly at constant torque.

The authors review 'AC machine fundamentals' in the first chapter using both 'field analysis' and 'equivalent circuit approach'. Most authors of electrical machines prefer to use the circuit approach and if at all, touch upon the field analysis. The authors have primarily used the field analysis. They devote a chapter on 'Special analytical methods' to approximate the B–H characteristic of the machine, which determines the performance of the hysteresis motor.

After taking the readers through a vigorous analysis of the machine, the authors deal with 'Performance and testing', and 'Design of hysteresis machines' with equal vigour. The chapters on 'Special hysteresis machines' and 'Magnetic materials' are useful and informative. The bibliography starting with the works of Steinmetz, is exhaustive and will provide excellent guidelines for researchers and designers of hysteresis machines.

Sadly, the book is unlikely to have a wide readership. Studying electrical machines is out of fashion these days and although it is taught in most engineering colleges in India as a small part of the undergraduate curriculum in electrical engineering, 'electromagnetic field theory' is seldom taught. Besides, few students choose 'electrical machines' for further studies.

Having said this, I would hasten to repeat that the book under review has enriched the literature on electrical machines and will serve as a comprehensive reference for anyone interested in hysteresis machines.

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Regional Groundwater Modeling. M Thangarajan. Capital Publishing Co, 7/28 Mahaveer Street, Ansari Road, Daryaganj, New Delhi 110 002. 2004. 340 pp. Price not mentioned.

The author has a long experience of groundwater modelling during his service at the National Geophysical Research Institute (NGRI), Hyderabad and a good part of that experience involved modelling assignments for regional groundwater assessment in different parts of India, with special focus on hard rock areas. The book has essentially evolved from this experience and covers a wide area of modelling applications in regional groundwater systems. Several case studies are discussed in some detail, which should be of interest to professionals in groundwater modelling. Thangarajan has himself been an investigator in some of these case studies and in that respect, the book draws heavily from the personal experience of the author, rather than the vast literature on groundwater modelling.

Regional groundwater modelling has practically come to mean numerical modelling with most of the models based on finite difference or finite element methods. In this context, the detailed example of the electric analogue model is perhaps inappropriate. Analogue models might have had some relevance when Thangarajan established this facility in NGRI in 1970s, but in a book published in 2004, the subject at best deserves a cursory mention. On the other hand, the mathematical modelling part could have been more rigorous, instead of fleeting details distributed at different places in the book. In fact, the lack of rigour in the mathematical part is a clear weakness of the book. There are several mistakes in discussions related to the equations, which could confuse a reader who refers to the book in the hope of learning regional modelling.

The contents of the book could have been organized better. The rather ad hoc structuring of the contents does not help a reader who is not familiar with groundwater modelling techniques. A perusal of the order of section titles of chapter 4, which is a key chapter of the book, clearly illustrates this deficiency of the book. With the same contents, restructuring the whole matter and eliminating apparent errors in regard to mathematical discussions might improve the quality of the book quite significantly.

There are two issues of regional groundwater modelling which are of great concern with regard to modelling requirements in India. These concern the uncertainty in the draft estimate and methods for recharge assessment during monsoon season. While there is some sketch coverage of these two important areas, the vast experience of the author with modelling might have been used to cover these areas in greater detail.

In view of the limitations highlighted in this review, the book may be of some benefit to professionals and academics with some experience in modelling regional groundwater systems, rather than to a student who wants to learn groundwater modelling. The lack of rigour in the book is not conducive to systematic learning of the subject.

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PERSONAL NEWS

V. M. Thakor

Veteran scientist and octogenarian, Vidyadhar Manjulal Thakor passed away on 23 June 2004 at Ahmedabad at the age of 83. Thakor obtained his doctorate degree from Royal Institute of Science, Mumbai under the guidance of late R. C. Shah, the then Advisor to Government of India and Deputy Director of National Chemical Laboratory, Pune. He started his career at the Gujarat College, Ahmedabad; he participated in the freedom movement in 1942 and was wedded to khadi all his life. Thakor published many of his papers on coumarins and chomones in international journals like *Journal of Organic Chemistry* (*JOC*) and *Journal of the Chemical Society* (*JCS*). He had more than 150 scientific research papers to his credit. He guided 22 Ph D students.

Thakor was the Founder-Head of the Department of Chemistry at Saurashtra University, Rajkot that was established in 1979. He also acted as the Vice-Chancellor of Saurashtra University for six months. He authored a thesaurus in Gujarati which was well received in Gujarat. He spent most of his time in Saurashtra, especially as Principal of Bahauddin Science College, Junagadh, then at M.P. Shah Arts and Science College at Surendranagar and later at H and H. B. Kotak Science Institute, Rajkot.

During his career as a researcher, Thakor worked on Fries, Friedel–Crafts rearrangement, Dakin oxidation, Pechmann condensation, Kostanecki–Robinson acylation, Ulmann condensation, Gattermann formylation and Claisen rearrangements. He had several publications on polyhydroxy coumarins, chormones, 3-chromenes, 3-chromenols, pyrilium salts, flavones and flavonols, chalcones and also on natural products from various plant isolates from petrocarpus Marsupium, *Cariudrum sativum*, *Pristimera indica*. His three papers in *JOC* related to formylation of benzopyrans and synthesis of 5, 6, 7, 8-tetrahydroxy coumarins were well received. (*JOC*, 22, 1626, 1630, 2223; 1957; *JCS* 1955; 5350.) Citation of these papers is included in Rodd's *Chemistry of Carbon Compounds* and in F. M. Dean's *Oxygen Ring Heterocyclic Compounds*.

Thakor's interest also led him to utilize many organic compounds as analytical reagents and he developed methods for detection and determination of copper, nickel, cobalt, titanium, platinum and palladium.

As a teacher, he wrote an excellent handbook on chromatographic techniques and ran many workshops on semi micro techniques for college and university teachers in the 70s and 80s.

Thakor was working on Woodward's rule in spectroscopy on natural products, but could not complete his findings. He initiated work on 4-hydroxy coumarins, 3-hydroxy coumarins, benzofuran formation by Perkin–Ebert–Fittig rearrangement and applied this mechanism to 4-halocoumarins for optimization and succeeded. He had also worked upon novel synthesis of substituted bergapten, psoralene and their derivatives, which remain unpublished.

To his credit a recent Indian patent had been filed (2001). His research students, now at various levels of academic positions have continued to work on many ideas regarding heterocyclic synthesis of naturally occurring products cultivated by Thakor and are pursuing his goal.

During retirement, he donated his entire savings to charitable trusts devoted to health, education, physically disabled persons, and woman and child welfare. He donated his body to the Medical College at V. S. Hospital, Ahmedabad. He is survived by his sister and brother. The R.C. Shah Memorial Lecture-Award for chemistry, biology and related research branches given by the Indian Science Congress Association (ISCA) to encourage young researchers is based on an endowment of Rs 100,000 donated by Thakor to ISCA. Dr V.M. Thakor Education and Research Trust promoted many activities under his chairmanship including the above ISCA award. Young researchers should take inspiration from a classical organic chemist and professor of merit like Thakor.

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