

## Bibliography

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Ashcroft, N. W. and N. D. Mermin, *Solid State Physics*, Holt, New York (1976).

Cohen, M. L. and S. G. Louie, *Fundamentals of Condensed Matter Physics*, University of Cambridge Press, Cambridge, UK (2016).

Hook, J. R. and H. E. Hall, *Solid State Physics*, 2<sup>nd</sup> ed., John Wiley & Sons, New York (2013).

Kittel, C., *Introduction to Solid State Physics*, 8<sup>th</sup> ed., John Wiley & Sons, New York (2013).

Rogalski, M. S. and S. B. Palmer, *Solid State Physics*, Gordon and Breach Science Publishers, Amsterdam (2000).

School, D. S., *Solid State Physics: From the Material Properties of Solids to Nanotechnologies*, Mercury Learning and Information, Dulles, VA (2017).

Singh, R. J., *Solid State Physics*, Pearson India, Delhi (2011).

Snoke, D. W., *Solid State Physics: Essential Concepts*, Addison-Wesley, San Francisco (2009).

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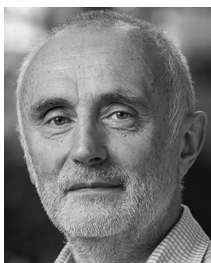
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