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ENGINEERING PHYSICS

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Department of Science & Humanities

ENGINEERING PHYSICS

Unit III : Application of Quantum Mechanics to Electrical transport in Solids

➢ *Suggested Reading*

1. *Fundamentals of Physics, Resnik and Halliday, Chapter 41*
2. *Solid state Physics, S.O Pillai, Chapter 6*
3. *Concepts of Modern Physics, Arthur Beiser, Chapter 9*
4. *Learning material prepared by the department-Unit III*

➢ *Reference Videos*

1. *Physics Of Materials-IIT-Madras/lecture-24.html*

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Unit III : Application of Quantum Mechanics to Electrical transport in Solids

Class #26

Graphical representations :

- *Density of states g(E)*
- *Density of occupied states N(E)*

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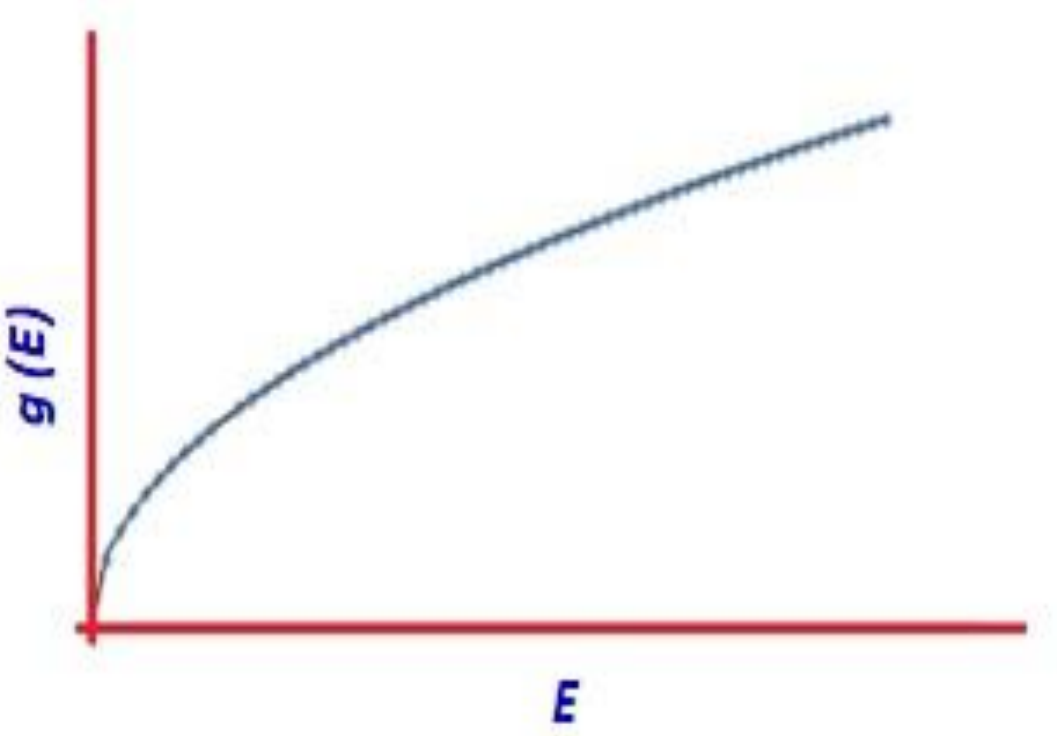
Graphical representation of density of states

The density of states for free electrons in a metal per unit volume $g(E)dE = \frac{\pi}{2}\left(\frac{8m}{h^2}\right)^{\frac{3}{2}} E^{\frac{1}{2}}\, dE$



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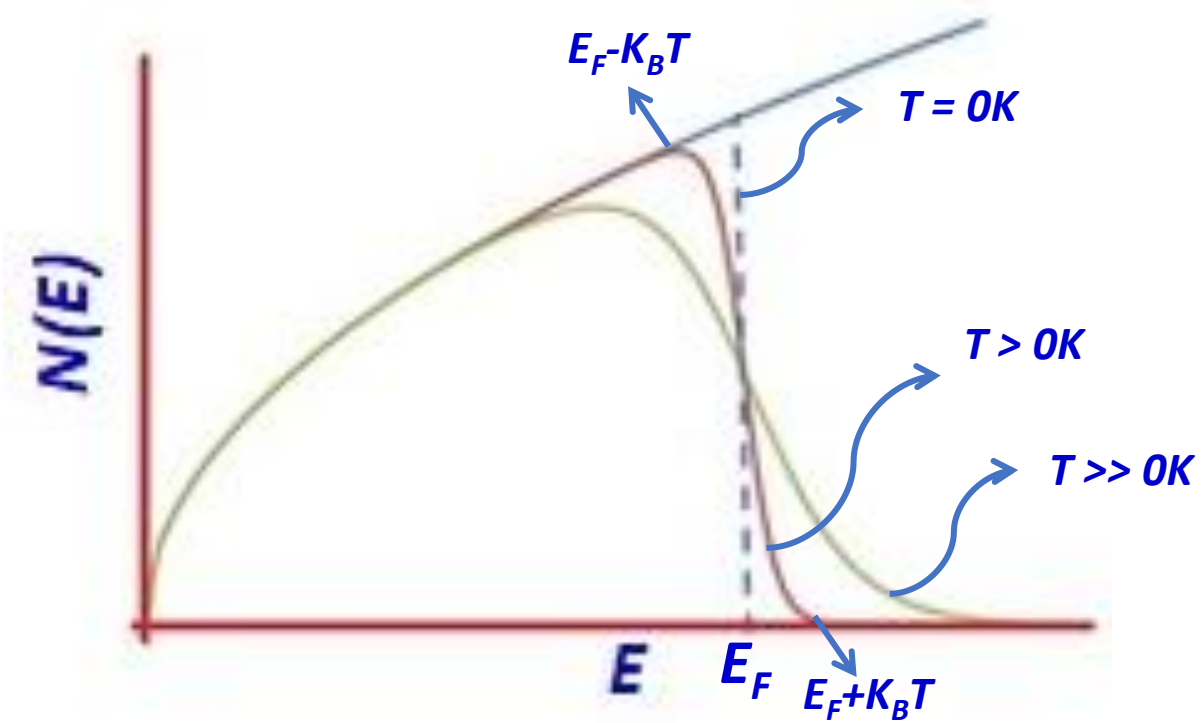
Graphical representation of density of states

Occupancy of energy states $N(E) = g(E) * F(E)$



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Density of occupied states N(E)

Density of occupied states N(E) when evaluated for all levels from 0 to E_F result in the total count of electrons in the metal

$$n = \int_0^{E_F} N(E)\, dE$$

$$N(E) = \int_0^{E_F} g(E) * F(E) dE$$

$$at\ T = 0\ K,\ \ F(E) = 1$$

$$n = \int_0^{E_F} g(E)\, dE$$

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Density of occupied states N(E)

$$= \frac{\pi}{2}\left(\frac{8m}{h^2}\right)^{\frac{3}{2}} \int_0^{E_F} E^{\frac{1}{2}}\, dE$$

$$n = \frac{\pi}{3}\left(\frac{8m}{h^2}\right)^{\frac{3}{2}} E_F^{\,3/2}$$

where n is the number of electrons per unit volume

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Class 26 . Quiz …

The concepts which are correct are….

1. *The probability that an energy state is occupied is given by the Pauli's exclusion principle.*
2. *The distribution of electrons in different energy states varies as $E^{-1/2}$.*
3. *At T > 0K, the states below E_f – KT are completely occupied*
4. *The occupancy of the energy states is determined by the factor N(E)= g(E)x F(E).*

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THANK YOU

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