

Course outline

How does an NPTEL online course work?

Week 1

Week 2

Week 3

Week 4

Week 5

 Reflection and transmission amplitudes and coefficients

 Transfer matrix for a rectangular barrier

 Electron tunneling through a periodic potential

 The tight-binding approximation

 Tridiagonal matrices and continued fraction

 Plane-wave basis for nearly free electrons

 Nearly free electron approximation

 Dynamical aspects of electrons in band theory

 Semiconductor crystals

 Week 5 Feedback Form: Solid State Physics

 Quiz: Week 5: Assignment 5

Week 6

Week 7

Week 8

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Lecture notes

Solutions

Week 5: Assignment 5

The due date for submitting this assignment has passed.

Due on 2021-09-29, 23:59 IST.

As per our records you have not submitted this assignment.

 The Fermi energy of copper is 7 eV. (use $h = 6.6 \times 10^{-34} \text{ J Hz}^{-1}$, $1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$, $m_e = 9.1 \times 10^{-31} \text{ kg}$)

1) The Fermi momentum of electron in copper is _____

2 points

 $16.48 \times 10^{-25} \text{ kg m/s}$
 $13.38 \times 10^{-25} \text{ kg m/s}$
 $12.48 \times 10^{-25} \text{ kg m/s}$
 $14.28 \times 10^{-25} \text{ kg m/s}$

 No, the answer is incorrect.
Score: 0

 Accepted Answers:
 $14.28 \times 10^{-25} \text{ kg m/s}$

2) The de Broglie wavelength of the electron is _____

2 points

 $3.84 \times 10^{-10} \text{ m}$
 $3.64 \times 10^{-10} \text{ m}$
 $4.64 \times 10^{-10} \text{ m}$
 $4.84 \times 10^{-10} \text{ m}$

 No, the answer is incorrect.
Score: 0

 Accepted Answers:
 $4.64 \times 10^{-10} \text{ m}$

3) The Fermi velocity is _____

2 points

 $2.32 \times 10^6 \text{ m/s}$
 $1.57 \times 10^6 \text{ m/s}$
 $4.57 \times 10^6 \text{ m/s}$
 $3.37 \times 10^6 \text{ m/s}$

 No, the answer is incorrect.
Score: 0

 Accepted Answers:
 $1.57 \times 10^6 \text{ m/s}$

 4) If electrons are treated as distinguishable particles, at what temperature would they have an average energy of 5.5 eV? (use $k_B = 1.3806 \times 10^{-23} \text{ J/K}$)

2 points

 $8.88 \times 10^4 \text{ K}$
 $6.38 \times 10^4 \text{ K}$
 $6.88 \times 10^4 \text{ K}$
 $8.38 \times 10^4 \text{ K}$

 No, the answer is incorrect.
Score: 0

 Accepted Answers:
 $6.38 \times 10^4 \text{ K}$

5) For a simple square lattice, the kinetic energy of a free electron at a corner of the first zone is higher than that of an electron at the mid point of a side face of zone by a factor of _____

2 points

 2

 4

 6

 1

 No, the answer is incorrect.
Score: 0

 Accepted Answers:
2

 6) The fcc lattice has 12 neighbours at a $(0, \pm 1, \pm 1)$, $a(\pm 1, 0, \pm 1)$, $a(\pm 1, \pm 1, 0)$. Using the tight binding approximation, the energy band constructed from an atomic s-state can be given by

2 points

 $E(\mathbf{k}) = E_0 - \alpha - 4\beta(\cos k_y a \cos k_z a + \cos k_z a \cos k_x a + \cos k_x a \cos k_y a)$
 $E(\mathbf{k}) = E_0 - \alpha - 8\beta(\cos k_y a \cos k_z a + \cos k_z a \cos k_x a + \cos k_x a \cos k_y a)$
 $E(\mathbf{k}) = E_0 - \alpha - 4\beta \cos k_x a \cos k_y a \cos k_z a$
 $E(\mathbf{k}) = E_0 - \alpha - 8\beta \cos k_x a \cos k_y a \cos k_z a$

 No, the answer is incorrect.
Score: 0

 Accepted Answers:
 $E(\mathbf{k}) = E_0 - \alpha - 4\beta(\cos k_y a \cos k_z a + \cos k_z a \cos k_x a + \cos k_x a \cos k_y a)$