İzmir Kâtip Çelebi University
Materials Science and Engineering
Mse228 Engineering Quantum Mechanics
Final Examination
June 06, 2018 10:30 – 12:30
Good Luck!

NAME-SURNAME:

SIGNATURE:

ID:

DEPARTMENT:

DURATION: 120 minutes

◇ **Answer all the questions.**
◇ **Write the solutions explicitly and clearly. Use the physical terminology.**
◇ **You are allowed to use Formulae Sheet.**
◇ **Calculator is allowed.**
◇ **You are not allowed to use any other electronic equipment in the exam.**
◇ **I declare hereby that I fulfilled the requirements for the attendance according to the University regulations and I accept that my examination will not be valid otherwise.**

Question	Grade	Out of
1A		15
1B		15
2		20
3		20
4		20
5		20
TOTAL		110

1. A) Draw an energy-level diagram showing the lowest four levels of singly ionized helium. Show all possible transitions from the levels and find the wavelength for each transition.

B) A collection of hydrogen atoms in the ground state is illuminated with ultraviolet light of wavelength 59.0 nm. Find the kinetic energy of the emitted electrons.

2. An electron is trapped in a one-dimensional region of length 1.00×10^{-10} m (a typical atomic diameter). (a) Find the energies of the ground state and first two excited states. (b) How much energy must be supplied to excite the electron from the ground state to the second excited state? (c) From the second excited state, the electron drops down to the first excited state. How much energy is released in this process?

3. Calculate the average orbital radius of a 1s electron in the hydrogen atom.

4. Calculate the energy difference between the $m_l = 0$ and $m_l = +1$ components in the 2p state of atomic hydrogen placed in an external field of 2.00 T.

5. The ground state of helium has the configuration $1s^2$. Use the electron screening model to predict the energies of the following excited states of helium: (a) $1s^1 2s^1$ (measured value -4.0 eV); (b) $1s^1 2p^1$ (-3.4 eV); (c) $1s^1 3d^1$ (-1.5 eV).