編號： 41

# 國立成功大學 109 學年度碩士班招生考試試題

系　　所：物理學系

考試科目：近代物理學

考試日期：0211，節次：3



※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1、Use the uncertainty principle to obtain the ground state energy of a linear oscillator. (10%)

2、Find the allowed values of the total angular momentum quantum number $j$, for an atom with spin $s$ and $\ell$, respectively. (10%)

3、Describe briefly each of the following effects or principle:

(1) Zeeman effect (5%)
(2) anomaly Zeeman effect (5%)
(3) Lamb shift　(5%)
(4) correspondence principle (5%)

4、An atom can exist in two states: a ground state of mass M and an excited state of mass M + Δ. If the transition from ground to excited state is through the absorption of a photon, what must be the photon frequency in the laboratory where the atom is initially at rest? (10 %)

5、We may generalize the semiclassical Bohr-Sommerfeld relation

$$\oint \vec{p} \cdot d\vec{r} = 2\pi\hbar\left(n + \frac{1}{2}\right)$$

to apply to the case where an electromagnetic field is present by replacing $\vec{p} \to \vec{p} - e\,\vec{A}/c$. The convention for Lorentz force is $\vec{F} = -\frac{e}{c}\vec{v} \times \vec{B}$. Use this the equation of motion for the linear momentum $\vec{p}$ to derive a quantized condition on the magnetic flux of a semiclassical electron, which is in a magnetic field B in an arbitrary orbit. (20%)

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6、The ground state of Hydrogen atom is given as

$$\psi_0 = \frac{1}{\sqrt{\pi a_0^3}} e^{\frac{r}{a_0}}$$

where $a_0$ is the Bohr's radius. Find the position, where the electron density in the hydrogen atom is maximum. (10%)

7、A particle of mass *m* moves in a 2-D potential well, $V(x,y)=0$ for $0 < x < a$ and $0 < y < a$, with walls at $x = 0$, $a$ and $y = 0$, $a$. Obtain the energy eigen functions and eigen values. (20%)