Test exam for Experimental Physics 3 (IPSP) (WS 2012/13)

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Note: Please write your name and matriculation number on EACH sheet of paper.
Use a new sheet of paper for each exercise.
You have 90 min. to answer the following questions:

Name:							
Mat. No.							
Exercise:	1	2	3	4	5	6	
Points:							
Points total				50			
Points scored							

Exercises:

1. The standard household wall-outlet voltage in Europe is 220 V, about twice that used in the United States. If a European traveler wants her hair dryer to work properly in the United States should she use a transformer that has more windings in its secondary coil than in its primary coil or vise versa? (4 Points)

2. A 100-turn coil has a radius of 4.00 cm and a resistance of 25.0 Ω. The coil is in a uniform magnetic field that is perpendicular to the plane of the coil. What rate of change of the magnetic field strength will induce a current of 4.00 A in the coil? (8 Points)

3. A coil is connected to a 60-Hz ac generator with a peak voltage equal to 100 V. At this frequency, the coil has an impedance of 10 Ω and a reactance of 8.0 Ω.
   (a) What is the peak current in the coil?
   (b) What is the phase angle between the current and the applied voltage?
   (c) A capacitor is put in series with the coil and the generator. What capacitance is required so that the current is in phase with the generator voltage?
   (d) What is the peak voltage measured across this capacitor?
   (12 Points)

4. Suppose a radiating electric dipole lies along the z axis. Let I_1 be the intensity of the radiation at a distance of 10 m and at angle of 90º. Find the intensity (in terms of I_1) at a distance of 20 m and an angle of 30º. (6 Points)

5. The electric fields of two harmonic electromagnetic waves of angular frequency ω_1 and ω_2 are given by $\mathbf{E}_1 = E_{1,0}\cos(k_1 x - \omega_1 t)\hat{j}$ and by $\mathbf{E}_2 = E_{2,0}\cos(k_2 x - \omega_2 t + \delta)\hat{j}$. For the resultant of these two waves, find
   (a) the instantaneous Poynting vector and
   (b) the time-averaged Poynting vector.
   (c) Repeat Parts (a) and (b) if the direction of propagation of the second wave is reversed so that $\mathbf{E}_2 = E_{2,0}\cos(k_2 x + \omega_2 t + \delta)\hat{j}$. (12 Points)

6. On a safari, you are spear fishing while wading in a river. You observe a fish gliding by you. If your line of sight to the fish is 64.0° degrees below the horizontal in air, and assuming the spear follows a straight-line path through the air and water after it is released, determine the angle below the horizontal that you should aim your spear gun in order to catch dinner. Assume the spear gun barrel is 1.50 m above the water surface, the fish is 1.20 m below the surface, and the spear travels in a straight line all the way to the fish. Draw a sketch including all variables. (8 Points)