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**University Examinations 2016/2017**

SECOND YEAR, FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE PHYSICS AND BACHELOR OF EDUCATION SCIENCE

**SPH 3201 ELECTRICITY & MAGNETISM II**

**DATE: December, 2016 TIME: HOURS**

**INSTRUCTIONS:** *Answer question* ***one*** *and any other* ***two*** *questions.*

**QUESTION ONE - (30 MARKS)**

1. (i) State the Gauss’ law. (1 Mark)

(ii) State two advantages of the Gauss’ law over Coloubs law. (2 Marks)

1. (i) Differentiate between mutual inductance and self inductance. (2 Marks)

(ii) State Faraday’s law of electromagnetic induction. (1 Mark)

1. A narrow coil of 10 turns and area $4 x 10^{-2}m^{2}$ is placed in a uniform magnetic field of flux B = $10^{-2}$T so that the flux links the turns of the coil at 60$°$. Calculate the average induced emf if it is removed completely from the field in 0.02 seconds. (5 Marks)
2. State the types of energy losses occurring in transformers. (4 Marks)
3. A capacitor of area $2 x 10^{-2}m^{2}$ and a plate separation 2mm has a dielectric of dielectric constant 1.2 is charged to 200V. Calculate the amount of energy stored in the capacitor. (5 Marks)
4. A 4$μF$ capacitor is charged to 50V and then discharged through a $5.0 x 10^{5}Ω$ resistor. Determine the potential difference across the plates of the capacitor after 18 seconds of discharging. (4 Marks)
5. An AC voltage source has an output given by;

$$V=200 Sin2πft$$

The source is connected to a 100$Ω$ resistor. Find;

1. Root mean square voltage (3 Marks)
2. Root mean square current (3 Marks)

**QUESTION TWO (20 MARKS)**

1. An AC generator consists of 100 turns of wire each with an area of 0.045$m^{2}$with total resistance of 15$Ω$. The coil rotates in magnetic field of strength 0.5T at a frequency of 50Hz, with the axis of rotation perpendicular to the direction of the magnetic field.
2. Find the maximum induced e.m.f (4 Marks)
3. Induced maximum current. (2 Marks)
4. Deduce the induced e.m.f as functions of time. (2 Marks)
5. Explain why a spark occurs between the poles of a switch when the switch is closed and not when it is opened. (5 Marks)
6. A solenoid of 300 turns and length 25cm has a crossectional area of $4.0 x 10^{-4}m^{2}$.
7. Calculate the self inductance ($μ\_{0}$= $4π x 10^{-7} J.m/A$ (4 Marks)
8. Find the self induced e.m.f in the coil if the current of the solenoid decreases at the rate of 50A/S. (3 Marks)

**QUESTION THREE (20 MARKS)**

1. Study the circuit below and use it to answer the questions that follow;
2. Find the time constant of the circuit. (2 Marks)
3. Current flowing after 1 time constant. (5 Marks)
4. Potential drop across the inductor after 1 time constant. (2 Marks)
5. Potential drop across the inductor and 1 time constant. (3 Marks)
6. Rate of change of current after 1 time constant. (3 Marks)
7. A motor has coils of resistance 20$Ω$ and supplied with 120V. When the motor is at maximum speed of rotation the back emf is 40V.
8. Find the current in the coils when the motor is first turned on. (3 Marks)
9. Calculate the current when the motor is rotating at its maximum speed (3 Marks)

**QUESTION FOUR (20 MARKS)**

1. A capacitor is charged fully by a 200V battery. It is then discharged through a small coil of resistance wire embedded in a thermally insulated block of specific heat capacity

2.5 x$10^{2}Jj kg^{-1}k^{-1}$ and mass 0.1kg. If the temperature of the block rises by 0.8k. What is the value of the capacitance C.? (6 Marks)

1. The plates of a parallel plate air capacitor consisting of 2 circular plates each of 10cm radius and 2mm apart are connected to the terminal of an electrostatic voltmeter. The system is charged to give a reading of 100V on the voltmeter scale. The space between the plates is filled with oil of dielectric constant 4.7 and the voltmeter reading falls to 25V. Assuming that voltage recorded is proportional to the scale reading, calculate the capacitance of the voltmeter. (10 Marks)
2. If the system in 4b above was discharged through a resistor of resistance 1000$Ω$, what would be the time constant? (4 Marks)