PRACTICE EXAM

Difficulty: MEDIUM

Questions: 10

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# Exam: Magnetic Fields and Applications

## Instructions:

Answer all questions to the best of your ability. Show your work where applicable.

## Multiple Choice Questions (2 points each)

Instructions: Choose the best answer for each question.

**Question 1:** Inside a long conductor of radius 'a' carrying a steady current I, at a distance r < a from the center, the magnetic field H is:
A) Constant and independent of r.
B) Zero.
C) Proportional to 1/r.
D) Proportional to r.

**Question 2:** Outside a long conductor of radius 'a' carrying a steady current I, at a distance r > a from the center, the magnetic field H is:
A) Proportional to r.
B) Proportional to 1/r.
C) Zero.
D) Constant and equal to the field at r = a.

**Question 3:** What is the magnetic field inside the core of a toroidal coil (r < a)?
A) Directly proportional to the current I.
B) Inversely proportional to the number of turns N.
C) Zero.
D) Uniform and non-zero.

**Question 4:** Which type of sensor uses the principle of inductance to measure displacement with submillimeter precision?
A) Proximity Sensor
B) LVDT (Linear Variable Differential Transformer)
C) Optical Sensor
D) Thermal Sensor
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Short Answer Questions (4 points each)

Instructions: Answer each question in 2-3 complete sentences.

Question 5: Explain how the magnetic field inside a long conductor (r < a) changes as the distance 'r' increases from the center of the wire.

Question 6: Describe the key difference in calculating the magnetic field inside (r < a) and outside (r > a) a long current-carrying conductor using Ampere's Law.

Question 7: Briefly explain how a proximity sensor works.

Problem-Solving Questions (6 points each)

Instructions: Provide detailed solutions, showing all steps and reasoning.

Question 8: A long wire with radius a = 2mm carries a current of I = 5A. Calculate the magnitude of the magnetic field (H) at a distance r = 1mm from the center of the wire.

Question 9: A toroidal coil has N = 100 turns and carries a current of I = 2A. Qualitatively describe the magnetic field inside the toroid. Justify your answer using Ampere's Law.

Question 10: Describe how you would determine the mutual inductance between a long straight wire and a rectangular loop placed near the wire. What parameters would you need to know, and what steps would you take?
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