EE 242 Section 1
Test 1
March 23, 1999

Name _____

This test consists of four main sections. Each section has several questions. Each question is worth 4 points unless shown otherwise. **Full** credit is only given for correct answers with work shown. Indicate the answer to each question by underlining it or boxing it in. Be sure to support your answers (show your work).

Notation:

x : unit vector in the x–direction ("x–hat")

y : unit vector in the y–direction ("y–hat")

z : unit vector in the z–direction ("z–hat")

Formulas you may find useful:

$$\langle f(t) \rangle = \frac{1}{T} \int_0^T f(t)\, dt$$

$$\int_s (\nabla \times \mathbf{A}) \cdot d\mathbf{s} = \oint_c \mathbf{A} \cdot d\mathbf{l}$$

$$\int_v \nabla \cdot \mathbf{A}\, dv = \int_s \mathbf{A} \cdot d\mathbf{s}$$

$$\nabla \cdot (\nabla \times \mathbf{A}) \equiv 0$$

$$\nabla \times (\nabla \phi) \equiv 0$$

$$\nabla \cdot (\mathbf{A} \times \mathbf{B}) = \mathbf{B} \cdot (\nabla \times \mathbf{A}) - \mathbf{A} \cdot (\nabla \times \mathbf{B})$$

$$\nabla \times (\nabla \times \mathbf{A}) = \nabla(\nabla \cdot \mathbf{A}) - \nabla^2 \mathbf{A}$$

(B)

EE 242: Engineering Electromagnetics

HOUR TEST #1 **September, 25, 98** **GRADE :**_____

Name:_____
(Last) **(First)**
ID #:_____

This test contains ten questions, some of which have several parts. Each question is worth ten points total. Full credit is only given to the correct answer. No partial credit is given if work is not shown neatly. Please work carefully.

Use the following complex scalars in the first three questions.

a= -3+j4 **b=2+j3** **c=9 $e^{j\pi}$**

Q1:

a) Find a+b in rectangular form.

b) Find a-b in rectangular form.

c) Find ab (a times b) in rectangular form.

d) Find a+a*.

e) Find bb*

Q2: a) Express a and b in phasor (polar) form.(6pts.)

b) Find b/a in polar form and rectangular form.(4 pts.)

Q3: Find the square root of c and give your answer both in polar and rectangular form.

Q4: a) Find the phasor notation of the following function.(5 pts.)

$$\text{Cos}(120\pi t + \pi/3) + 3\ \text{Sin}\ (120\pi t)$$

b) Find c(t) in terms of ωt from the phasor shown below. (5 pts.)

$$c = 10\ \exp(j0.5)$$

The following complex vectors go with questions 5, 6, 7.

$\bar{A} = \hat{x}\,3 - \hat{y}\,4$

$\bar{B} = \hat{y}\,4 + \hat{z}\,5$

$\bar{C} = \hat{x}\,4\sin(y) + \hat{z}\,j2\cos(y)$

Q5: Find $\bar{A} \times \bar{A}$.

Q6: Find $\bar{A} - \bar{B}$.

Q7: a) Place $\bar{C}$ into the time domain. (5 pts.)

b) Find the time average of $\bar{C}(t)$. (5 pts.)

$\langle \bar{C}(t) \rangle =$

Q8: a) State the Maxwell's equation based on Ampere's law and obtain three scalar equations from one vector equation. (6 pts.)

b) Give the definitions for $\bar{H}$, $\bar{D}$, $\bar{J}_{cond}$, and ρ_v . (4 pts.)

Q9: Maxwell's equation based on Faraday's law of induction is given below.

$$\nabla \times \bar{E} = -j\omega \bar{B}$$

Using this equation find the magnetic field $\bar{B}$ (y,t) associated with the electric field $\bar{E}$ (y, t).

$$\bar{E}(y, t) = \hat{x}\, 0.5 \cos(\omega t + ky) \quad V/m$$

ω and k are constants.

Q 10: Given below are scientists or engineers in the left column and their contributions to the field of electromagnetics in the right column. Match the scientist or the engineer to the appropriate contribution by putting the # corresponding to the scientist or engineer infront of the contribution.

SCIENTIST OR ENGINEER	CONTRIBUTION
1. Hertz	a) The operator ∇^2 is named after him.
2. Heaviside	b) He invented the first electric generator.
3. Marconi	c) The unit of electric charge is named after him.
4. Faraday	d) He is responsible for the Maxwell's equation:
5. Gauss	e) Magnetic flux density is named after him.
6. Ampere	f) In 1901, he transmitted radio waves across the Atlantic Ocean.
7. Maxwell	g) This eccentric British telegrapher invented the ionosphere
8. Laplace	h) In 1887 he proved that radio waves exist and can be reflected.
9. Coulomb	I) EM fields obey this scientist's equations.
10. Tesla	j) An absent minded French engineer who forgot the dinner invitation of the emperor Napolean.

RESERVE