Q6) *Given a vector field* $\vec{A} = \rho\cos(\varphi)\,\vec{a\rho} + \sin(\varphi)\,\vec{a\varphi}$. *Find the* ***closed line integral*** ($\oint \vec{A}.\vec{dl}$) *around the contour shown in figure 1. Also, use* ***Stokes's theorem*** *to justify your answer. Is* $\vec{A}$ *a conservative field or not? Explain your answer.*

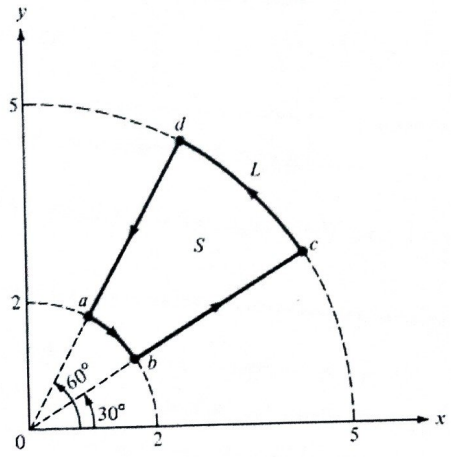

Figure 1: For Q6.

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Q7) *A uniform plane wave in a nonmagnetic medium has* $\vec{E}(z,t) = 100\cos(10^8 t + 2z)\,\vec{ay}\ (\frac{V}{m})$. *Find:*

- ***I.*** *The time-harmonic expression of the electric field.*
- ***II.*** *The direction of propagation.*
- ***III.*** *The wave polarization.*
- ***IV.*** *The wavelength and frequency of the wave.*
- ***V.*** *The relative permittivity of the medium.*
- ***VI.*** *The intrinsic wave impedance and the phase velocity.*
- ***VII.*** *The expression of the magnetic field in time-harmonic and real-time forms.*

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توزيع درجات الامتحان

السؤال	الدرجة	السؤال	الدرجة
1a	5	4	8
1b	5	5	8
2a	5	6	8
2b	5	7	8
3	5	كتابة الاسم ورقم القيد	3

تمنياتي لكافة الطلاب والطالبات بالتوفيق والنجاح في هذا الامتحان وفي كامل المسيرة الدراسية.

استاذ المُقرر: محمد خليفة المزوغي.

كلية التقنية الالكترونية
College of Electronic Technology - Tripoli

Electromagnetics I | *Final Exam* | *Fall 2020*

Instructor: Eng. Mohamed K. Elmezughi | *Time Allowed: 120 minutes*

Answer all the following questions and show your work step by step.

Q1) a) *Write down the four* ***Maxwell's Equations*** *in the differential form for the* ***Free Space*** *condition and identify each term.*

****

b) *Let the volume charge density within a spherical region of a radius* $\boldsymbol{R = 20cm}$ *be given by the expression* $\boldsymbol{\rho_V = 4 + 8Kr^2}$ $(\frac{C}{m^3})$. *Determine the constant* ***K*** *value that will make the total charge in the spherical region equal to* ***Zero.*** *For this value of* ***K****, what will be the value of the electric field external to this region?*

****

Q2) a) *Given the following volume charge density in a sphere of radius* $\boldsymbol{10\ m}$*:*

$$\rho_V = \begin{cases} 100 - r^2, & r < 10 \\ 0, & r > 10 \end{cases}$$

Write the expressions of the electric field inside and outside the sphere. Also, sketch the electric field versus $\boldsymbol{r}$.

****

b) *A line charge density* $\boldsymbol{\rho_L = 3\sin^2(\varphi)}$ *exists in a ring defined by* $\boldsymbol{\rho = 4}$ *and* $\boldsymbol{Z = 2}$. *Find the total charge of the ring.*

****

Q3) *A charged particle with velocity equals to* $\vec{v} = v_x\,\overrightarrow{ax} + 6\,\overrightarrow{ay} + v_z\,\overrightarrow{az}$ *is moving in a medium containing uniform fields. If the electric field is* $\vec{E} = 10\,\overrightarrow{ax}$ *and the magnetic flux density* $\vec{B} = 2\,\overrightarrow{ay}$. *what should be the velocity (as a vector and a magnitude) so that the particle experiences No force on it (****i.e., the Lorentz Force is Zero****).*

****

Q4) *Given that* $\varepsilon_0\vec{E} = z\rho\cos^2(\varphi)\overrightarrow{az}$ $\left(\frac{C}{m^2}\right)$, *calculate the volume charge density at* $(1, \frac{\pi}{4}, 3)$ *and the total charge enclosed by a cylinder of radius* $\boldsymbol{1m}$ *with* $|z| \leq 2m$.

****

Q5) *Given point* $\boldsymbol{P(-2,6,3)}$ *and vector* $\vec{A} = y\,\overrightarrow{ax} + (x+z)\overrightarrow{ay}$, *express* ***P*** *and* $\vec{A}$ *in both the cylindrical and spherical coordinate systems.*

****

كلية التقنية الالكترونية
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طرابلس

قســـم هندسة الاتصالات

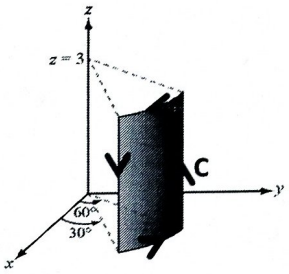
أسئلة الامتحان النهائي لمادة : كهرومغناطيسية 1

لطلبة الفصل : الخامس للفصل ا لدراسي : خريف 2016

اسم الأستاذ/المنسق : د عادل سعد

الزمن: ساعتان

Q1) A vector field is given by $\vec{C} = \frac{\cos\phi}{\rho}\vec{a}_z$ on a segment of a cylindrical surface defined by $\rho = 2$, $30^\circ \le \phi \le 60^\circ$ and $0 \le z \le 3$ as shown in the Fig.



[i] Calculate the curl of $\vec{C}$ [3M]
[ii] Is stokes's theorem satisfied? and why?[6M]

Q2) Two constant vectors, $\vec{A} = 2\vec{a}_x + 3\vec{a}_y + 3\vec{a}_z$ and $\vec{B} = -\vec{a}_x - 5\vec{a}_y - \vec{a}_z$, are located at the point P(2,3,3) in Cartesian coordinate system.

[i] Calculate $\vec{A} \times \vec{B}$ [3M]
[ii] Determine the magnitude and unit vector of $\vec{A}$ [3M]
[iii] Express $\vec{B}$ in cylindrical coordinate system[3M]
[iv] Find the smaller angle between $\vec{A}$ and $\vec{B}$ [3M]

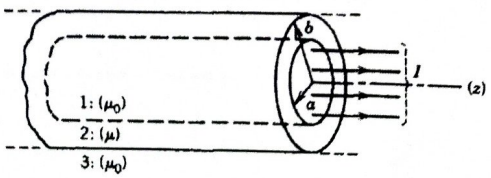
Q3) an electric field $\vec{E} = x \sin \omega t \, \vec{a}_x$ V/m is given to exist in a certain region, with a relative dielectric constant $\varepsilon_r = 2$ find the following fields:

[i] The electric polarization field $\vec{P}$.[3M]
[ii] The polarization bound charge density ρ_p .[3M]
[iii]The displacement flux density $\vec{D}$.[3M]
[iv]The polarization current density $\vec{J}_p$.[3M]

Q4) Two extensive homogeneous isotropic dielectrics meet on plane $x = 0$. For $x \ge 0$, $\varepsilon_r = 2$ and for $x \le 0$, $\varepsilon_r = 4$. A uniform electric field $\vec{E}_1 = 2\vec{a}_x + 8\vec{a}_z$ kV/m exists for $x \ge 0$, there is no free charge on the interface. Find $\vec{E}_2$ and $\vec{D}_2$ for $x \le 0$. [9M]

Q5) Point charges 1 mC is located at (3, 2, -1) and -2 mC is located at (-1, -1,4). Calculate the electric force on a 10-nC charge located at (0, 3, 1) and the electric field intensity at that point[9M]

Q6) A very long, nonmagnetic conductor of radius a carries the static current I as shown in Fig. The conductor is surrounded by a cylindrical sleeve of nonconducting magnetic material with a thickness extending from $\rho = a$ to $\rho = b$ and the permeability μ. The surrounding region is air.



a) Find $\vec{H}$ and $\vec{B}$ in the three regions. [3M]
b) Find the $\vec{M}$ field in the three regions. [3M]
c) Find the volume magnetization current density $\vec{J}_m$ within the magnetic sleeve. [3M]

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