ELEKTROMAGNETSKA POLJA 16-18h A211

UTO + ČET

4. SEMESTAR

BODOVI:

1. MI 30 } SVE [illegible]
2. MI 30 } [illegible]
3. MI 25 + 10

[illegible] [illegible] 5 BODOVA

[illegible] → [illegible] 3 [illegible] [illegible] [illegible]

DZ 3 x 2 = 6 BODOVA

LABOS 3 x 5 bodova = 15 BODOVA

LITERATURA

[illegible] - ETFOS ELEKTROMAGNETIZAM I + II [illegible]

S. [illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible] [illegible]

prof. Martin Dadić

TEMELJNI POSTULATI ELEKTROMAGNETIZMA

- TEMELJNI ZAKONI
- COULOMBOV, BIOT-SAVARTOV, AMPEROV ZAKON
- FARADAYEV ZAKON
- OHMOV ZAKON – JEDNADŽBA KONTINUITETA

MAXWELLOVE JEDNADŽBE

- SKALARNO POLJE
- VEKTORSKO POLJE

KARTEZIJEV PRAVOKUTNI SUSTAV

ELEKTRIČNO I MAGNETSKO POLJE

- LORENTZOVA SILA

$$\vec{F} = Q(\underbrace{\vec{E}}_{\text{el. polje}} + \underbrace{\vec{v} \times \vec{B}}_{\text{mag. polje}})$$

2) $v = 0$

$$E = \lim_{Q \to 0} \frac{F}{Q}$$

$\boxed{2.1}$ Elektron upada u područje u kojem vlada el. polje $\vec{E}$ s početnom brzinom $\vec{v}_0$ prema slici. Odredite putanju elektrona, ako je zanemariva gravitacijska sila?

l = duljina ploče

$$\vec{F} = m\vec{a} = m\left(\vec{a}_x \frac{d^2x}{dt^2} + \vec{a}_y \frac{d^2y}{dt^2} + \vec{a}_z \frac{d^2z}{dt^2}\right)$$

jedinični vektori $\vec{i} = \boxed{\vec{a}_x}$ $|\vec{a}_x| = 1$

$\vec{j} = \boxed{\vec{a}_y}$ $|\vec{a}_y| = 1$

$\vec{k} = \boxed{\vec{a}_z}$ $|\vec{a}_z| = 1$

$\vec{E} = E\,\vec{a}_y$; $\vec{v}_0 = v_0\,\vec{a}_x$

$$-e\,E\,\boxed{\vec{a}_y} = m\left[\vec{a}_x \frac{d^2x}{dt^2} + \boxed{\vec{a}_y}\frac{d^2y}{dt^2} + \vec{a}_z \frac{d^2z}{dt^2}\right]$$

izjednačujemo po komponentama

$$-eE = m\frac{d^2y}{dt^2}$$

$$\frac{dy}{dt} = -\frac{eE}{m}t + C \qquad \text{1. integracija}$$

$t = 0$ $v_y = 0$

$\rightarrow C_1 = 0$

2. integracija

$$y = -\frac{eE}{m}\frac{t^2}{2} + C_2\,;$$

poč. uvjet $t = 0$

(I) $$y(t) = -\frac{eE}{m}\frac{t^2}{2} \qquad \text{PARABOLIČNA PUTANJA}$$

(II) $\vec{a}_x$

$$0 = m\frac{d^2x}{dt}$$ 2 puta integriramo + početni uvjeti daje

$x = V_0 t + C_2$

$C_2 = 0$

$\boxed{x = V_0 t}$ [illegible]

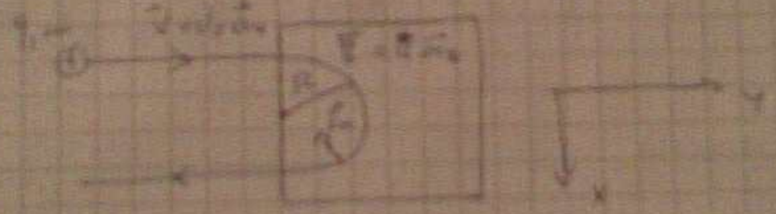
(II)

$m \frac{d^2 z}{dt^2} = 0$

$z = 0$

26.02.

2



⊗ u ploču

⊙ iz ploče

$\vec{F} = q(\vec{E} + \vec{v} \times \vec{B}) = q(\vec{v} \times \vec{B})$

$\vec{B} = B \vec{a}_z$

$\vec{F} = m \frac{d\vec{v}}{dt}$

$m \left(\frac{dv_x}{dt} \vec{a}_x + \frac{dv_y}{dt} \vec{a}_y + \frac{dv_z}{dt} \vec{a}_z \right) =$

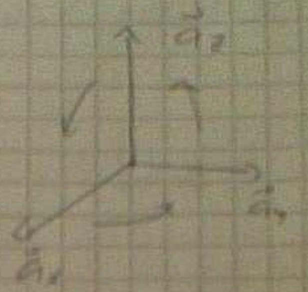
$= q \left[\left(v_x \vec{a}_x + v_y \vec{a}_y + v_z \vec{a}_z \right) \times \left(B \vec{a}_z \right) \right]$

$\vec{a}_z \times \vec{a}_z = |\vec{a}_z| \sin 0 = 0$

$\vec{a}_x \times \vec{a}_z = -\vec{a}_y$

$\vec{a}_y \times \vec{a}_z = \vec{a}_x$

$\vec{a}_z \times \vec{a}_z = 0$



Izjednačavanje x komponente i [illegible] , [illegible]
strane

$$Q \Big[\quad = Q B \left(-\vec{a}_y v_x + \vec{a}_x v_y \right)$$

(I) z-komponenta

$$\frac{dv}{dt} = 0 \Rightarrow v_z = konst$$

$v_{z0} = 0 \Rightarrow v_z = 0$ [illegible] [illegible] [illegible] [illegible]

(II) x-komponenta

(1) $m \dfrac{dv_x}{dt} = Q \cdot B v_y \qquad (uz \ \vec{a}_x)$

(III) y-komponenta

(2) $m \dfrac{dv_y}{dt} = -Q B v_x \qquad (uz \ \vec{a}_y)$

v_y preko v_x i v_x preko v_y izraziti

(2) $m \dfrac{dv_x}{dt} = Q B v_x \quad \Big| \dfrac{d}{dt}$

$\dfrac{d^2 v_x}{\ } = - Q B \dfrac{dv_x}{\ }$

$$\frac{dv_x}{dt} = -\frac{m}{QB}\frac{d^2 v_y}{dt^2}$$

$$-m^2 \frac{1}{QB}\frac{d^2 v_y}{dt^2} = Q B v_y$$

$$\frac{d^2 v_y}{dt^2} + \frac{Q^2 B^2}{m^2} v_y = 0$$ [illegible] harmonic oscillator

$$\omega^2 \rightarrow \boxed{\omega = \frac{QB}{m}}$$

$$\boxed{v_y(t) = A \sin(\omega t) + B \cos(\omega t)}$$

[illegible]

$$\frac{mv^2}{R} = QvB \qquad R = \frac{mv}{QB}$$

$$v = \omega R \qquad R = \frac{m\omega R}{QB} \rightarrow \omega = \frac{QB}{m} = \frac{QB}{m}$$

$$v_x = -\frac{m}{QB}\frac{dv_y}{dt}$$

$$v_x = -\frac{1}{\omega}\frac{dv_y}{dt}$$

$$v_x = -\frac{1}{\omega}\left[(A\omega \cos(\omega t)) - \omega B \sin(\omega t)\right]$$

$$\left.\begin{array}{l} B = v_0 \\ A = 0 \end{array}\right\} \begin{array}{l} v_y(t) = v_0 \cos(\omega t) \\ v_x(t) = v_0 \sin(\omega t) \end{array}$$

$$v_x = \frac{dx}{dt}$$

$$x = \int v_x\,dt = -\frac{v_0}{\omega}\cos(\omega t) + C_1$$

C_1 [illegible]

[illegible] $x(0) = 0$, $v(0) = 0$ $\Rightarrow$ $C_1 = \frac{v_0}{\omega}$

$$y = \int v_y\,\partial t = \frac{v_0}{\omega}\sin(\omega t) + C_2$$

$$y(0) = 0 \Rightarrow C_2 = 0$$

[illegible]

$$x(t) = \frac{v_0}{\omega}\left[1-\cos(\omega t)\right]$$

$$y(t) = \frac{v_0}{\omega}\left[\sin(\omega t) + 0\right]$$

[illegible] [illegible] [illegible]

$$R = \frac{v_0}{\omega} \qquad v_0 = R\,\omega$$

– Mikroskopska i makroskopska teorija –

$\int$ [illegible] E

$\oint$ [illegible] B

– Singularne gustoće

– Linijski naboj λ $Q = \int_l \lambda \, dl$

– Točkasti naboj